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CONTENTS.

☞ An asterisk (*) denotes an illustrated article

EDITORIALS—
New England Association of Gas Engineers..... 67
The XLIII Annual Report of the Philadelphia Gas Trust..... 67
The Plumber and Sanitary Engineer..... 68
The Paraffines in Water Gas, as now Made in New York.. 68
On the Hayford Process and Apparatus for Preserving Timber..... 69
West of Scotland Association of Gas Managers..... 70
Midland Association of Gas Managers..... 71
Preparation of Ammonia from Gas Liquor and Uses of Ammoniacal Salts..... 74
On Coal Dust Explosions..... 75
Early History of the Steam Engine..... 75
Gas-Light Intelligence..... 76
The Revivification of Foul Lime..... 76
On the Relative Attraction of Oxygen for Hydrogen and Carbonic Oxide..... 77
The Rothschonberger Water Adit..... 77
Relative Cost of Water and Steam Power..... 77
Delicate Machinery..... 78
Preservation of Wood..... 78
Water Tanks..... 78
Chemical Society..... 78
Mineral Statistics of the United Kingdom..... 78
Prices of Gas Coals..... 78

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NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

OFFICIAL NOTICE.

The annual meeting of the Association will be held at the Tremont House, Boston, on Wednesday, February 20th, 1878, at 12 o'clock, noon.

At the last annual meeting of the Association it was voted that the sum of fifty dollars be paid from the funds of the Association to the member presenting the best original dissertation upon any subject connected with the manufacture of illuminating gas, from substances of which coal is the principal ingredient.

A further sum of fifty dollars was offered by Geo. D. Cabot, Esq., late President of the Association, to be devoted to the same purpose; thus making the prize or reward for the best dissertation, as stated above, one hundred dollars.

Members intending to compete for the prize are requested to forward their papers to the Secretary, at least one week before the time of the annual meeting, in order that he may lay such papers before the Directors for their inspection, giving them ample time for examination, and for a fair and careful examination of their comparative merits.

At the same meeting a special committee was directed to prepare a list of questions relative to the operations of the several companies under the charge of the different members of the Association; and that the Secretary cause said questions to be printed in convenient form and distributed among the members, to be answered by them and returned to him in season for their tabulation and presentation to the Association, at the next annual meeting. These questions will be forwarded to each member in a few days. The undersigned requests that the blanks may be filled out and the papers returned to him on or before the first day of February next.

The answers, in compliance with the wish of the committee, must be based upon the business of the year 1877, except in the case of those companies which do not close their financial year with the secular year. Their answers may be based upon the business of their financial year which closes the nearest to the date of this notice.

Members intending to propose any persons for membership at the annual meeting, are requested to send to the Secretary the names of such persons as soon as possible.

GEO. B. NEAL, *Secretary*,
BOSTON, Jan. 1, 1878.

THE XLIII ANNUAL REPORT OF THE PHILADELPHIA GAS TRUST.

The operations of the Philadelphia gas works for the past year, under the management of the Trustees, are set forth in a report made to the City Councils last week. By this report it appears that the expenditures for the year were $854,676.55. The gas made was 2,110,677,000 cubic feet, being a decrease of 43,600,000 from last year's make.

The largest consumption in any twenty-four hours was on December 24th, and amounted to 9,319,000 cubic feet, which was an increase over last year's greatest daily send-out of 525,000 cubic feet.

There were 84,530 feet of mains laid during the year, making a total of 690½ miles in the city.

The whole number of street lamps in the city, on January 1st, 1878, was 11,738, of which 11,260 were supplied with gas by the Philadelphia gas works, and the rest by the Northern Liberties company.

The net profits of the works for the year, after paying all expenses, and the amounts due the various sinking funds, amount to $5,394.40, making the total accumulated profits, up to the end of 1877, $3,068,338.

The reasons given for the falling-off in the net profits for the year, are mostly the same as those affecting all gas companies, viz.: The depression in trade and business has caused a falling off in private consumption alone of 96,000,000 feet. The reduction in the price received for street lamps, from $2.30 to 2.15 per thousand, makes the receipts $90,000 less than for last year. The reduction in the price of coke and tar makes a difference against the works of $43,000. In addition to these local causes, such as extensive repairs upon wharfs, renewal of retorts consequent upon the heavy consumption during the Centennial, and the removal of lime kilns, etc., have added materially to the expenses of the year.

The average illuminating power was 16.39 candles; the greatest amount of gas made in any one day was 7,954,000 cubic feet. There were used 243,723 tons of coal (short tons.) The number of meters introduce was 3,226, making a total of 92,727. The total number of consumers on the books of the Trust amounts to 93,759.

The total number of lights in use is now 1,361,836.

New works are nearly completed in the 25th Ward, which will be the largest in the country, all the connections being 48-inch. The gas man-

ufacture at all the various works of the Trust is under the immediate charge of the able engineer of the Philadelphia gas works, Mr. Thomas R. Brown, under whose management many important improvements have been effected; and to whom is due the highest credit for the management of the manufacturing department.

Since writing the above it is with sincere regret we learn that Mr. Thos. R. Brown, the engineer of the Philadelphia gas works, is confined to his bed with an illness of a very serious character. It is said that he is constantly attended by two physicians, and that most serious results are to be feared.

His many friends will, we feel sure, join us in the earnest hope that relief will be speedily afforded him, and that he may be long spared, in renewed health to discharge the arduous duties of his position which he has so well performed in the past.

THE PLUMBER AND SANITARY ENGINEER.

This is a new monthly journal which has reached its third number.

Its object is to occupy a field never before taken up by any special journal It is not a *trade journal*, but its intention is to instruct and inform not only the plumbers but the public as to what are the true requisites of really scientific and proper work, in that most important branch of house-fitting, from which the community have suffered so much from improper service.

The proper plumbing of a house is of more importance to its occupants than the planning—much of the disease, discomfort, and ill health of our population comes directly from bad plumbing; and the causes are sometimes so cunningly concealed that the uninformed are unable to detect them. The field open to the new journal is a wide one, and if the course thus far pursued by it is adhered to, there is no doubt but that it will render a good public service. Its opinions are not for sale for the advancement of any individual interest, but its aim is to instruct all who are willing to learn in the true principles of Scientific Sanitary Engineering.

[Communicated Article.]

The Paraffines in "Water Gas," as Now Made by the Tessie du Motay Process in New York.

By Henry Morton, Ph.D., and William E. Geyer, B.S.

In collecting some time since a portion of gas supplied by the Municipal Gas Company, of New York, who are working a "water-gas" process, it occurred to us to examine a portion which had passed through a series of tubes immersed in a freezing mixture of ice and salt, and which had there deposited a notable amount of volatile liquid.

On making the analysis of this gas, in the usual method, we were surprised to find no change in the proportion of the "olefines," or "illuminants,"* so-called, as compared with the gas which had not been subjected to any refrigeration.

This indicated that the liquid removed by the cooling treatment did not consist as we supposed beforehand, of members of the aromatic series, or the like; but of paraffines, or members of the marsh-gas series, which would not be absorbed by Nordhausen acid, or by bromine, and would not, therefore, be reckoned as olefines.

This, of course, raises the question as to whether it is possible to determine by the usual method of eudiometric analysis the composition of a mixture containing hydrogen, marsh gas, and one or more higher members of the marsh gas or paraffine series.

In reference to certain members of this series it has already been established that such a determination is not possible. Thus, Bunsen in his "Gasometrische Methoden," 1877, p. 249, states that two volumes of marsh gas give exactly the same results by eudiometry as equal volumes of hydrogen and ethane. See also Sutton, in his "Volumetric Analysis," 1871, p. 338.

Indeed it might seem hardly necessary to discuss this question further; but as an opposite assumption has been made the basis of a large amount of work, and has been accepted, unchallenged in some quarters, to a considerable extent, we will venture to give such a demonstration as we think will leave no doubt about the matter in the mind of any one.

Thus, in the first place, to take a simple case. Suppose we have a mixture of hydrogen, marsh gas, and ethyl hydride:

Let x = the volume of the hydrogen (H).
" y = " " marsh gas (CH_4).
" z = " " ethyl hydride (C_2H_6).
" V = the entire volume of mixed gases.
" C = the volume of carbonic acid produced by explosion.
" A = the amount of contraction produced by explosion.

Then—

$$x+y+z=V \quad \ldots\ldots (1)$$

$$y+2z=C \quad \ldots\ldots (2)$$

$$-\frac{3}{2}x+\frac{5}{2}y+2z=A \quad \ldots\ldots (3)$$

Clearing equation (3) of fractions gives—
$3x+4y+5z=2A$, combining with equation (2)
$y+2z=C$, gives
$3x+3y+3z=2A-C$. Dividing both sides by 3 gives

$$x+y+z=\frac{2A-C}{3}$$

which is clearly an identical equation with (1) and thus leaves us with only two equations from which to find the values of three unknown quantities. In other words the result is indeterminate, and an infinite number of values for x, y and z, will satisfy equations (1,) (2,) and (3), which represent the actual results obtained by the analysis.

If, as some chemists prefer, we take for the foundation of our third equation, the amount of oxygen consumed we shall fare no better, for, representing by O the amount of oxygen consumed in explosion, this third equation becomes—

$$\tfrac{1}{2}x+2y+\frac{7}{2}z=O \quad \ldots\ldots (4.)$$

Clearing this of fractions we get—
$x+4y+7z=2O$ ..... Subtract from this 3 times equation (2) $=3y+6z=3C$
and we have

$$x+y+z=2O-3C$$

which again is an identical equation with equation (1).

Yet, again, if we resort to a determination of the water formed even this will not help us, for, calling W the volume of water formed, our third equation becomes—

$$x+2y+3z=W \quad \ldots\ldots (5)$$

and if we subtract equation (2)

$y+2z=C$ as before, we get
$x+y+z=W-C$, again an identical equation with (1).

As a further illustration we give, in a tabular form, a series of values for the three constituents in a mixture of hydrogen, marsh gas, and ethyl hydride actually containing eight volumes of each, and thus having for V or its volume 24, for the carbonic acid produced 24, and for the contraction on explosion 48.

The actual volumes of each gas being eight, the observed results would be equally consistent with any of the following assumed compositions.

H	12	11	10	9	8	7	6	5	4	3	2	1	0
CH_4	0	2	4	6	8	10	12	14	16	18	20	22	24
C_2H_6	12	11	10	9	8	7	6	5	4	3	2	1	0

Of course an infinite number of fractional values might be intercalated, and as far as the results of analysis would inform us, any one of these sets of values would be as likely to be the true one as any other.

The reasoning which we have applied here to these three substances may be shown to be general to any members of the paraffine series as well.

In making such application the following table will be useful as a memorandum. The vertical columns indicate the successive members of the marsh gas or paraffine series, as well as hydrogen, which, in a certain sense, comes in here as a sort of sub-member of the group; and the horizontal lines indicate the volumes produced, consumed, or absorbed, as stated in each case:

	H	CH_4	C_2H_6	C_3H_8	C_4H_{10}	C_5H_{12}
CO_2 formed	0	1	2	3	4	5
Contraction	1½	2	2½	3	3½	4
O consumed	½	2	3½	5	6½	8
H_2O formed	1	2	3	4	5	6

From this it appears that these usual methods of analysis are inapplicable to mixtures containing a series of three or more paraffines, or of two or more paraffines and hydrogen.

In this connection it may seem curious that we find in the Proceedings of the Am. Philos. Society, Vol. XVI., pp. 206 and 585 an extensive research on the "Composition of the Natural Gas from certain wells in Western Virginia," by Samuel P. Sadtler, in which the composition of numerous specimens of gas containing, among other things, hydrogen, marsh gas, and ethyl hydride, is given on the basis of results obtained by the usual process of eudiometry, or, in other words, from the volume taken, the amount of carbonic acid formed, and the contraction after explosion.

On reference to the early part of the paper, however, we find the explanation of this in an error which at first sight might be supposed to be merely a misprint, but which examination shows is the foundation of the whole system of determinations; and which, when corrected, destroys the entire superstructure which has been built upon it. This so fatal error is the self-evident one of assuming the contraction of hydrogen on explosion to be three times its volume, and not once and a half or three halves of its volume. Thus in place of our equation (3)—

$$-\frac{3}{2}x+\frac{5}{2}y+2z=A$$

Prof. Sadtler has

$$3x+\frac{5}{2}y+2z=A.$$

Now, when this is cleared of fractions, and

---

* Such substances as olefiant gas, acetylene, benzole, etc., which are absorbed by Nordhausen acid, or bromine, and are in practice thus withdrawn from a mixed gas and determined in the usual process of analysis.

combined with equation (2), etc., as before, it gives—

$$-2x+y+z=\frac{2A-C}{3}$$

which, in place of being identical with equation (1) will, by combination with it, give—

$$x=\frac{2A-C}{3}-V$$

from which, of course, all the other unknown quantities can be found by the aid of the other equations.

Thus, by reason of this error, Prof. Sadtler has found a solution in appearance where no solution was possible, and his determinations have therefore no value whatever.

Such being the case, as regards the possibility of determining a mixture of paraffines by the usual methods of analysis, and the error which their presence would introduce into the determination of the hydrogen and marsh gas in the ordinary manner, it became very important, for practical purposes, to determine in the first place if the amount of these paraffines, in the water-gas under examination, was considerable. Fortunately this was easily accomplished by reason of the large solubility in alcohol of these paraffines. Thus while alcohol dissolves at the ordinary temperature (say, 62°F.) of nitrogen, 0·120 vols., of hydrogen, 0·067 vols., of carbonic oxide, 0·204 vols, of marsh gas, 0·477 vols. ; it dissolves of ethane (ethyl hydride), 1·130 vols., of propane a large amount (about 6 vols.), of butane, 18 vols., and the higher members of the series in yet larger amounts.

By, therefore, removing the olefines with Nordhausen acid, and the oxygen and carbonic acid with pyrogallic acid and caustic potash, and then introducing alcohol whose vapor was in turn removed by Nordhausen acid, it was easy to determine, at least roughly, the amount of these higher paraffines present.

The result of this treatment in fact showed that they did not exceed about one per cent.

The influence of their presence upon the results of analysis would, therefore, not be of any practical importance. They would diminish the apparent proportion of hydrogen and increase that of marsh gas slightly. Thus the average of two analyses of the same gas, made in the usual method, compared with the results of the analysis of another portion collected at the same time, and which had been treated with alcohol as above, shows this very plainly.

	Results of ordinary analysis		Gas treated with alcohol.
	Normal gas.	Frozen gas.	
Carbonic acid	.327	.446	18.050
Oxygen	.561	.793	
Olefines	16.323	16.360	
Carbonic oxide	27.337	27,536	26.790
Marsh gas	25.985	23.626	21.646
Hydrogen	24.889	27.157	27.897
Nitrogen	4.572	4.072	4.243
Paraffines	not est'd	not est'd	.702

We also give here the analysis of some of the same gas which had been exposed to a freezing mixture of ice and salt, as mentioned at the beginning of this paper.

In order to get some notion of the character of the paraffines contained in this gas it was passed for an hour in a small stream through absolute alcohol. This alcohol was then heated in a water bath, and the large volume of gas which it liberated was collected in a graduated tube. From about 200 ccm. of alcohol 210 ccm. of gas were obtained; 130 ccm. of this was absorbed by bromine, showing that so much consisted of what we call the "olefines," etc., or "illuminants." Of the remainder about 10 per cent. proved to be oxygen* and carbonic acid, with about five per cent. of carbonic oxide.

On treating the remainder with a quantity of absolute alcohol, amounting to about 4 mm. in the absorption tube, this promptly absorbed six times its volume; withdrawing this and introducing four more measures of alcohol, this absorbed 3½ times its volume. Another portion of alcohol absorbed 1½ times its volume. After this the absorption was not greater than would be due to the slight absorption of marsh gas, hydrogen, and nitrogen.

The promptitude with which these absorptions took place, as well as their large amount, showed clearly that among the substances present must be some of the higher and more soluble of the marsh gas series. On diluting the alcohol (which had been boiled thoroughly for some time to expel the last traces of gas) it became cloudy, and after standing threw up a distinct layer of oil, which had a very strong odor, resembling that of allylene and crotonylene.

* A large part of this was derived from the alcohol which contained 2½ per cent. of oxygen and 7½ per cent. of nitrogen. Motives of convenience determined our leaving this, and not removing it beforehand by boiling.

On the Hayford Process and Apparatus for Preserving Timber.

By Edward R. Andrews, of Boston.

[We take pleasure in laying before our readers to-day the first instalment of the above-named paper, which was recently read at the rooms of the American Society of Civil Engineers.—Ed.]

As introductory to the main subject, a few statistics of the rapid consumption of the timber of this country, an explanation of the causes of decay in wood, and the scientific principles which are the basis of every successful method of arresting and preventing decay, will not be out of place.

The subject of *wood preserving* has not received the attention of scientific and practical men in this country, which its importance as a valuable industry demands for it. In Europe it is not only well understood, but preserved wood is generally used.

Maxime Paulet, a French chemist, in a large octavo volume on this subject, published in 1874, mentions not less than 173 different processes and apparatus, which have been patented or described in scientific works since the year 1700.

The most valuable systems were discovered between 1832 and 1838. Kyan, Bethell, Burnett, and Boucherie—whose names have been given to the methods employing corrosive sublimate, creosote, chloride of zinc, and sulphate of copper—introduced their several systems during that short period. All of these are in use in Europe, and scarcely any others, three of them, to a very limited extent, in this country.

In Europe, the use of preserved timber is the rule; here, it is the rare exception. Abroad, no question arises as to using preserved wood, and seldom as to the method; except in France, where sulphate of copper is largely used for railway ties, the Bethell system, or the impregnation of the pores of wood with the heavy oils of tar, known as creosote oils, has almost entirely superseded every other system.

In this country, the apparently inexhaustible supply of timber has retarded the general use of preserved wood. Yet, for some years, it has become evident that our supply is not inexhaustible. The drain is enormous; many parts of our country have been stripped of forests altogether. The statement is made, in *Scribner's Monthly* for December, that the annual lumber product of the whole country is ten thousand millions of feet. A very considerable portion of this product is to replace what was cut four to ten years before, and has decayed.

Consider for a moment the consumption of wood in the one item of railroad ties. Massachusetts, employing mostly chestnut ties, which last on an average six years, uses up in this way, annually, a volume of lumber nearly equal to the whole product of Maine; and the 80,000 miles of track in the whole country, allowing four years as the average life of ties, actually use up in ties alone one thousand six hundred millions of feet annually, or equal to one-sixth of the timber product of the whole country.

Add to this the consumption of wood for fences along the lines of railways, the bridges, platforms, etc., and it is easy to see that if some effort be not soon made to lengthen the life of railroad timber, the supply will become insufficient.

There are also 76,000 miles of telegraph poles, requiring for their renewal annually 43,620,000 feet of wood, or nearly equal to the product of the State of Maine. Telegraph poles were first creosoted in England, twenty-seven years ago, and are as sound as at first, to-day. The English government is now creosoting all the telegraph poles in the United Kingdom.

In view of these facts, added to the cost of labor attending the renewal of decayed wood, it would seem that this country ought to be alive to the importance of preserving wood, in view of the results of European experience.

I do not find there is any lack of interest in this subject, only a lack of knowledge and of faith. That there is a lack of faith is not strange, because, as a rule, preserving has not added much to the life of timber in this country. This is, no doubt, partly due to the fact that those who have constructed works here, have put up a flimsy structure to fill some contract, or had some stock jobbing operation in hand, but also partly to the fact that the systems in use abroad are not fully adapted to meet the wants of this country.

Had either European system been so, it certainly would heve become general ere this. Our railroad engineers would not have continued the use of natural wood for ties, which last only four to six years, if through the use of the Bethell system their life could have been increased twenty or thirty years, as in England.

Here let us consider what decay in wood is, what it is caused by, and what is needed to prevent it. There are two kinds of decay, known as *Wet Rot* and *Dry Rot*.

Wet rot takes place in wood containing sap, which is exposed to moisture. It often commences in a living tree. It shows itself in the red streaks in the wood when felled, and woodmen recognize its existence its even before the tree is cut down. It is wet rot which destroys railroad ties, fence posts, telegraph poles and bridge timber. It is hastened by alternate moisture and dryness.

Dry rot, so called, needs moisture for its development as well as wet rot. It occurs in close, confined, damp localities, where there is imperfect ventilation. As a rule, it flourishes most actively in unseasoned lumber, but it also attacks seasoned lumber, when so placed that it can absorb moisture from its surroundings. *Dry rot* is that sort of decay which is found in cellars and basements, between the ceilings and floors of houses, etc. Wood used in such localities is of-

ten already in a state of decay when placed there. It comes by cars or vessel direct from the sawmill, and is framed at once, reeking with sap and moisture.

It is dry rot which destroys vessels, owing to confined air; the short life of wooden vessels is mainly attributable to this cause, and several of the methods for preserving wood were first used to prevent decay in the British Navy.

In localities where dry rot exists, and has destroyed one set of timbers, the seeds of decay are there still, ready to attack new timbers, unless the conditions can be entirely changed by ventilation or otherwise, and often such a change is impossible.

What is the cause of wet rot and dry rot? It is due primarily to the fermentation of the albumen in the sap, which commences as soon as the necessary conditions, heat and moisture, are provided. In a living tree, the unmatured sap rises from the ground through the sap wood, and after being transferred by the action of the leaves into true sap for the formation of woody fibre, it descends within the bark loaded with sugar, acids, albumen, etc., and forms the annual growth of wood, holding in abundance rich sap within its cells and fibres. So long as the tree lives, these processes go on naturally, but when the tree is cut down, and the leaves no longer perform their functions, the abundant sap clogs the pores, and is in a favorable condition to be acted upon by heat, and begins to ferment.

Fermentation causes the rapid development of countless myriads of spores of fungi always present. Animalculæ and insects follow, and the woody fibre is in time disintegrated, and although perhaps retaining the form of wood, it has lost all strength and tenacity, and crumbles to pieces at the slightest blow. Rot is, then, the growth and development of fungus and animal parasites.

Preserving Processes.

The prevention of the development of fungus, or its destruction with the animal life it nourishes, is, then the object of the various processes for preserving wood. The coagulation of the albumen of the sap is the only result obtained by the use of the metallic salts. Coagulation prevents the albumen from fermenting, and the spores of fungi lie dormant; both vegetable and animal life are arrested. As a protection against dry rot, where wood is not exposed to moisture, these systems are useful, but when wood is exposed to water, they are of little value, as a rule. They consist in impregnating the pores of wood with watery solutions. It is certain they will partially redissolve by water, and leave the wood unprotected, always liable to absorb water carrying with it destructive elements.

It is important, then, that the public should not confuse creosoting with Burnettizing, etc. They only act chemically upon the sap, but creosote oil, containing carbolic acid, cresylic acid, etc., not only produces the same result chemically, but also secures dryness. Creosoting fills the pores of wood with an insoluble oil, and covers the fibres with a film, which protects them from absorbing destructive elements from extraneous sources. The oil, which saturates the sap wood, and the outer pores of the heart wood, resinifies and hardens under the action of the air, and forms a waterproof and air-tight covering to the wood. If the heart wood be not too dense, it also absorbs a large quantity of oil, otherwise the oil absorbed by the sap wood works inwardly, being very penetrating in its character, and, in time, can be plainly seen through the whole tissue.

[To be continued.]

[From London "Journal of Gas-Lighting."]

West of Scotland Association of Gas Managers.

[Continued from page 53.]

Mr. Henry Aitken next read the following paper on—

The Aitken and Young Process.

I promised your secretary a paper for this meeting on "The Influence of Aqueous Vapors on Illuminating Gas," but since making that promise I have not found time to finish the necessary experiments then begun.

You will have seen in the *Journal of Gas-Lighting* for this week a most able and elaborate paper by M. Bremond, on the influence of aqueous vapors settling down naphthaline from illuminating gas. The results got by him differ to a certain extent from those got by me, no doubt owing to the difference in the character of the gas worked upon. I will not, however, enter upon this question at present, but proceed to open the discussion on the Aitken and Young process as mentioned in the programme.

At Hamilton, the analyzer is continuing to give perfect satisfaction, and the convener of the gas committee has written me that he considers they are effecting a saving of something like 20 per cent.

The size of the analyzer at Hamilton has been complained of, and no doubt the size is considerable for the amount of gas made; but when it is considered that it is not a costly erection, and that it requires no repair and little attention, it has much in its favor. We have other methods whereby we can reduce the size to a very great extent, which would possibly be adopted for large works.

The analyzer at the Glasgow Corporation works is not yet completed, but I expect to have it in operation in a few days.

The whole theory of the process is in keeping the tars and gases as much separate as possible, or if they do come in contact, it is only at such temperatures as will prevent the heavy tars from carrying down with them the lighter hydrocarbons, which form, to a great extent, the light-giving portion of the gas.

There can be no doubt that the light hydrocarbons in the tar are of a similar character to those you keep in the gases; and you have only to take some of your tar, heat it up to 212°, collect the products of distillation, and then allow the tar to remain until it is quite cold, spread it over shavings, or something of a like kind, to get surface to expose the tar on, and then pass gas through among the tar, to find that your gas has been robbed of something like 30 per cent. of its illuminating power. Distil this tar as on the first occasion, and you will get nearly the same products as by the first partial distillation.

The great object to be accomplished by the Scotch gas managers is to make, at the cheapest possible rate, gas of an illuminating power of 25 to 28 candles. They can get plenty of materials in this country at a cheap rate, that can, by the ordinary process of condensation, make gas of 20 to 21 candles; but they have to pay high prices for materials that will give them the additional five or six candles required. They will now have to determine whether it is cheapest to work in the old way, and use large quantities of cannel coal—much of it at high prices—or adopt the new process, and use cheap porrots, shales, and common coals. Some of the gentlemen who took part in the discussion at our last meeting seemed to think it was a great advantage to have tars rich in light hydrocarbons; but if you consider for a moment what these rich tars cost you, I do not think you will be of the same opinion. If their view of the question is correct, why not condense the gases so as to take a larger portion of the light hydrocarbons out of the gas? This could be accomplished at almost no expense whatever, and they might be able to double the amount of naphthas in their tars, and reduce their gas from 27 to something like 20 candles. The price of 100 lbs. sperm value of some of the coals and shales principally in use is as follows:

Boghead coal at 85s		4s. 2d.
Lesmahagow	" 35s	2s. 6d.
Wemyss	" 30s	2s. 2d.

Third class parrot coals containing from 700 lbs. to 900 lbs. sperm value, can be bought at from 7s. to 9s. per ton, which price gives 100 lbs. sperm value for 1s.

Shales, containing from 800 lbs. to 1200 lbs. sperm value, can be bought at from 5s. 6d. to 9s. 6d. per ton which gives 100 lbs. sperm value for from 8¼d. to 9½d.

Splint coals, containing from 600 to 700 lbs. sperm value, can be bought at from 5s. to 6s. 6d. per ton, which gives 100 lbs sperm value for from 9d to 11d.

These sperm values are arrived at by the old methods of condensation, and the prices are at the pits.

I think it may be assumed that the average price of all the gas making materials used in Scotland will be about 17s. to 18s. per ton at the gas works, and the quantity of gas produced per ton will average about 10,000 feet, or from 1s. 8d. to 1s. 9d. per 1000 feet. If the new method of condensation were adopted, gas of equal illuminating power could be made from the cheap materials before referred to, which could be bought at 11s. per ton at the gas works, and would produce about 8,700 feet, and so cost 1s. 3d. per 1000 feet of gas.

The difference in the relative values of the tars and water has now to be considered, and it is necessary to here draw a distinction between those who distil their own tars out and those who sell them as they are made. As the latter is the more general way of working, we will consider it in this relation. I think it may be assumed that the average price got for these all over Scotland will not exceed 2s. 6d. per ton of coal distilled. No doubt the tars got by the new way of working do not contain the naphthas, but, on the other hand, they can be sold as once-run coal tar, and the market price of this article is, I believe, higher at present than for crude tars, and there is a large market for them. How this market would be affected by a greatly increased supply I do not know, so that I cannot follow out this part of the question further. But it has to be borne in mind, under this head, that you have, besides the decrease in the cost of the gas producing materials, the following points in favor of the new process:

1. Gas more easily purified, and a saving of about 12 per cent. of lime.

2. Thirty per cent. more ammoniacal water, which at the present market price is worth about 6d. per ton of coal carbonized.

There are many other points in connection with the process, and as to the proper materials to be used, that it would be well to discuss, but I leave the further discussion to you, gentlemen, who have more practical knowledge than I have.

Mr. Stewart: As one of those engaged in testing this process, I would like to say a word or two about it. I agree with Mr. Aitken that there is not the least doubt of a considerable saving of first class coal by this process, and a considerable improvement in quality of the gas at the same time. In the ordinary process of manufacture we take second class coal, which we can purchase at from 11s. to 12s. per ton. You get from these 9,000 feet of gas per ton, and that is about 1s. 4d., on the average, for 27-candle gas. If you want from 28 to 30-candle gas, you must use first class coal, for which you will pay at least 22s. per ton. This coal contains a large quantity of gas, and it is easily distilled, and for that reason the price is higher than the mere proportionate value of the gas it contains would warrant. I have taken a great deal of interest in this scheme, because I see that first class coals are becoming scarcer and dearer, and, in the course of a few years, we will be driven to use second class coals only. If you have a rich coal, you can easily increase the quality of the gas, but we want to increase the quality from the coals we have, and in this direction I think the Aitken and Young process is the best invention which we have had brought before us for a long time. It certainly will, I think, stand further investigation. What the result may be in Glasgow I do not know; but so far as my

own testing goes, I am perfectly satisfied that it is a very good thing, and one that should receive consideration and attention from managers of gas-works.

Mr. Mitchell: I have listened with pleasure to Mr. Aitken's remarks upon this process. I spent a considerable time in assisting in the process, and from the beginning I looked upon it as a success. One thing that struck me very much at the last meeting of the North British Association was the great stress that a number of managers put upon having rich coal tar. They appeared to think that if coal tar was denuded of all its napthas before it left the gas-works it was a great disadvantage. That is not the opinion of managers in general. Their interest is to produce as good a gas as possible at a reasonable rate. Now, it is an undisputed fact that the sperm value is much easier acquired by using second class coals with this process than by using richer coals. I have no doubt of the ultimate success of the process.

Mr. Sugg: I would like to make a remark, not so much on the process, which I do not understand at present, as about M. Bremond, of Versailles, who was referred to by Mr. Aitken as using the water-vapor process. You have to consider that there is a difference between the gas made by him in Versailles and the gas you make here. M. Bremond was first led to the adoption of his principle of passing gas over caustic lime, and finally over quicklime, in order to get rid of naphthaline, and according to his own showing he does not get rid of it. I myself saw at his works two pipes, the one filled with naphthaline and the other not. The same gas passed through both, the only difference being that the gas to the one passed over quicklime and the other did not. That was his object in taking away the watery vapors. Then, in regard to carrying the gas along with the tar, that has been used in London and many parts of England, in order to get rid of the naphthaline. This, no doubt, increases the hydrocarbons in the tar. Some time ago, Mr. Harcourt, in a lecture, showed how the hydrocarbons, produced at a higher temperature, absorbed those produced at a lower temperature. Some years ago Mr. Evans pointed out that hydrocarbon vapors could be as well absorbed by tars or by oils as by bromine, and that if you passed gas over the oils or tars of any hydrocarbons produced at a high temperature, you would absorb these hydrocarbons. As you are never troubled with naphthaline, however, you never carry your gas along with the tar, in order to get rid of the naphthaline. What Mr. Aitken says is perfectly correct. If you take tar and distil it, and take out the the lighter hydrocarbons, it will take out the hydrocarbons of the gas, and, where the gas passes in contact with the tar, although it may get rid of the naphthaline, or prevent a deposition of naphthaline, there is no doubt, although it is disputed, that it reduces the illuminating power. In London, it is beginning to be noticed that it is better to get rid of the tar as quickly as possible from the hydraulic main, and there are several large works where I know they do this. I do not think this will have the effect of removing the naphthaline at all, but will rather have an opposite effect.

Dr. Wallace: The report which I gave upon the experiments I made at Hamilton has no doubt been placed in the hands of most gas managers in Scotland I have little to add, for I have not made any further experiments, though I expect to do so when the apparatus in Glasgow is completed. In regard to this process, if the object of the gas manager was to make tar rich in naphtha, this process would be the worst, but if he wants to make gas, and considers tar a secondary product, as it has always been considered, then I think this process is an immense step in advance of anything we have had before. The experiments made at Hamilton were, I think, tolerably complete. Perhaps the testing arrangments of the gas were not so perfect as they will be in Glasgow; but so far as I have been able to see, there is an improvement in the gas, and, strange to say, the difference in the quality of the tar has not been so much as I expected—that is to say, the whole naphtha has not been taken out of the tar. In the tar made at Hamilton, though the proportion of naphtha is less than in tar made in ordinary circumstances, yet there is something like half of the quantity left. I shall not be content until I see a larger proportion of the naphtha taken out than has been the case hitherto.

Mr. Young: I would like to say a few words before this discussion closes. We are indebted to Mr. Sugg for coming here. His presence and remarks show the advantage of intercommunication by people working out different ideas. He has made reference to the trouble experienced by naphthaline where poor coals are used, and he pointed out that the passing of gas over quicklime prevents the deposition of naphthaline. There are two ways of preventing the deposit of naphthaline from coal gas. The first is to remove it from the gas altogether, by exposing it to something that will absorb it—such as the method adopted when the tars and gases are allowed to travel some time together until they become perfectly cooled; and the second is to diffuse through the gases the vapors of some hydrocarbons which have an affinity for the vapors of naphthaline, and hold them in suspension. The former of these processes has been extensively adopted in England. However, we hear from our friend, Mr. Sugg, today that a number of managers are no longer believing in the efficiency of this process, as they are now taking off the tars at the hydraulic, and removing them from further contact with the gases. I think what has been brought before the meetings of this Association, in connection with the Aitken and Young process, has pretty clearly shown that this process of keeping the tars and gases in contact would be a losing one, because the very conditions which would enable the tars to absorb naphthaline from the gases would also enable them to absorb the naphtha vapors from the gases which are valuable as illuminants. The second process has been pretty extensively employed in America where volatile hydrocarbons, resulting from the first of the distillate of petroleum, have been employed to diffuse through gases containing naphthaline, and hold them in diffusion, and I have great hopes that this new analyzing process will have a like effect in preventing the deposit of naphthaline, as it diffuses through the gases a much larger quantity of naphtha vapors than is ordinarily done. Indeed, in England, when pipes have got choked up with naphthaline, it is a common practice to pour into these pipes naphthas, so that the vapors may dissolve the naphthaline and carry it forward in diffusion. With reference to the influence of watery vapors, it has been found that dry gases, when perfectly saturated with the vapors of hydrocarbons, such as benzole, can no longer hold them in suspension when brought in contact with watery vapors, their having the effect of inducing a precipitation of the denser vapors. Now, may not this drying of the gas have the effect of preventing the precipitation of some of the naphtha vapors, and thereby enable the gases to retain in diffusion the naphthaline which they may contain? I am strongly of opinion that this is the case. Then, in regard to the naphthas left in the tars, Dr. Wallace says that although this invention has been able to remove a certain quantity from the tars, and diffuse it through the gases, yet there is a certain quantity allowed to remain. I believe that, with the most perfect instrument, so long as we use rich coals there will be left a surplus of the denser naphthas, because the rich gases are not able to take up these naphthas and hold them in suspension. To utilize those denser naphthas it would be necessary to employ some poor gas-producing material. There is no doubt that this process effects a considerable saving, and that the principles on which it is based are sound, and gradually, as they are better understood, they will be more extensively adopted. It only requires a little time, perhaps, to develop the mechanical arrangements by which the most perfect results may be obtained.

Mr. Aitken: In regard to what Mr. Sugg has said about naphthaline, I may state that I met a gentleman who had put up works at Woolwich, and he had to employ three or four men to free the pipes and burners from naphthaline. He said that he immediately cured it by taking the gas and putting it into a large vessel, 30 feet high and five feet in diameter, full of coke, and pumping the tar through it. I asked him if he had tested the illuminating power, and he said he had not, but he was glad to get rid of the naphthaline and the men who were employed to prick the burners. The object of M. Bremond is to get rid of the naphthaline, and I must say I do not understand how naphthaline is formed—whether it is in the gas as it travels along in combination with other hydrocarbons, and is, so to speak, not a separate body in the gas, but simply a portion of that complex substance known as coal gas; or whether it is a separate body held in the gas under certain circumstances, and dropped under others. As I understand M. Bremond he favors the first idea; I incline, with Mr. Young, to the latter, and think further that it drops down from the gas with the aqueous vapors in the same way as the naphthas do when the gas is suddenly lowered in temperature. We know that dried gas will deposit only a very small amount of its naphthas on a sudden change of temperature, whereas undried gas deposits a very great amount, and the same law seems to apply to naphthaline. We also know that dried gas will take up the same amount of water as it contained before being dried, if water is presented to it, temperatures being equal. I cannot see my way through M. Bremond's article, but perhaps more study may convince me that what he says is correct. I think we shall accomplish what Dr Wallace points at, and take all the light naphthas out of the tars, or prevent them from getting in to them.

A vote of thanks was accorded to Mr, Aitken, on the motion of the President, and the discussion closed.

The next meeting of the Association was fixed to take place in Paisley, in April, 1878.

Votes of thanks to the President and to Mr. Carlow, the Secretary, brought the business meeting to a close.

In the afternoon the members of the Association, along with a number of the directors of the Helensburgh Gas Company, dined at the Imperial Hotel—Mr. McGilchrist in the chair, and Mr. Stewart, of Greenock, discharging the duties of croupier.

On the following day (Friday) a number of the members, with their friends, drove in waggonettes from Helensburgh up the Gareloch, thence along Loch Long to Arrochar, and from there to Tarbet, on Loch Lomond, where a picnic was held. Afterwards the company drove down Loch Lomond *via* Luss, back to Helensburgh, where all arrived safe, and well pleased with their day's enjoyment.

Midland Association of Gas Managers.

At the First General Meeting of the above Association, held at the Midland Hotel, Birmingham, on Thursday, Jan. 10, the following Inaugural Address was delivered by the President, Mr. Charles Hunt:

Gentlemen; It devolves upon me to say a few words, as appropriate as may be to the occasion which has brought us together, although, in doing so, I fear lest I may exhibit you as models of patience, rather than prove myself worthy of the privilege with which you have honored me.

In the first place let me congratulate this meeting upon the very rapid progress made by the Association, for although, as yet, only three months old, it numbers thirty members, a result which goes far to justify the most sanguine expectations which may be formed as to its future. On the threshold of this future, it may be well for us to consider what are the objects we intend to pursue.

Since the humble beginning made by Murdoch, in yonder factory at Soho, the history of gas-lighting has been one of continuous development, so that now our industry finds employment in nearly every quarter of the globe. Regarded at first with scant favor, its manufacture looked upon as a highly mysterious

occupation, more enlightened views have long since prevailed, new uses have been found for it, and the transference in many conspicuous instances, of the duties and responsibilities of its supply into the hands of Municipal Authorities, may be fairly regarded as sufficient proof, if no other existed, that coal gas is looked upon at the present day as a public necessity.

The important posi ion which it has thus acquired might be thought by some to furnish satisfrctory evidence of a corresponding progress in its manufacture; but such does not appear to be the opinion entertained in many quarters, if we are to judge from the frequent admonitions addressed to us to put our houses in order. We are repeatedly told, both by Parliament and the public, that we do not supply gas either good enough or cheap enough; our own familiar friends turn round upon us, and accuse us of having "degenerated;" while—unkindest cut of all:—from across the Channel has lately come to us a notice to quit the fair field of our labors so soon as our would be successor shall have completed his arrangements for entering into possession of it. Under these, or indeed any circumstances, what can gas managers do better than unite their scattered forces, and consult together as to the best means to be adopted for the protection and advancement of the interests entrusted to their care? In forming this Association, we are but following the example set us by our professional brethren in all parts of the kingdom, till retaining undiminished our attachment to the parent Association, the labors of which, during the ast sixteen years, in the promotion of a spirit of inquiry, and in the spread of information, have conferred infinite benefit upon gas manufacture. It is to be hoped that the day is near at hand when it and other kindred Associations will receive frem those who, after all, are the chief gainers by them—namely, gas companies and corporations, a yet more ample recognition than has hitherto been accorded to them, gratifying though this may be, for assuredly they fully deserve it.

During the past year or so the electric light has attracted considerable attention in France, where it has been applied for illuminating large buildings and open spaces; and opportunities are now afforded us for examining in this country its claims to public favor. There can be little doubt that much progress has, of late years, been made by way of perfecting its application, and the efforts of electricians have been partially successful in dividing the current of electricity, so as to produce, from the same source, a limited number of lights, or candles, as they are termed; but it is difficult to conceive that gas shareholders or corporations have anything to fear from it as to the value of their property, so long as it lacks so conspicuously that power of adaptation to varying cirquirements, the possession of which has contributed so powerfully to the success of the system of gas lighting.

Competition, to a limited extent, we may very likely experience in the immediate future; but there is room for both systems, and, if the rivalry so induced should act upon us a stimulus to further exertion, by way of cheapening and extending the use of gas, it will by no means be a matter for regret.

We are, indeed, spurred on to such exertions by a variety of motives. Parliament, in its wisdom, has thought fit, during the last year or so, to adopt a new principle in gas legislation, by imposing upon some of the metropolitan, and also upon a few provincial companies, a sliding scale of dividend, so that henceforth the amount of this latter will depend in their case, to a considerable extent, upon the selling price of the gas. Thus a sort of speculative element is introduced, or payment by results, as it has been termed, which would appear to operate to the advantage of both buyer an seller; but originating in a doubt, believed, by some at any rate, to have been ill-founded, as to the *bona fides* of the companies, it seems not unlikely to prove of greater benefit to them than to the consumers, in whose interest especially the proposal was framed. In fact an abnormal condition of things, such as was the late coal famine, during the existence of which the new regulations would, in all probability, operate in favor of the consumer, can never be lasting, and must always be far outweighted by succeeding years of comparative tranquility.

In another direction Parliament is likely to be more successful in limiting the profits of the companies, for by the auction clauses now generally inserted in new Acts, the shareholders are deprived of the premiums on fresh issues, while, at the same time, the question as to what is a fair dividend on gas capital, respecting which the decisions of the Legislature have been anything but consistent, is practically referred to the investing public, who may be relied upon to settle it to their own satisfaction, and, let us hope, to that of all other interests concerned. It would seem that the creation of non-dividend bearing capital, amounting practically to a reduced charge for dividend on all future issues, must tend ultimately to strengthen the position of the companies, while the benefit to the consumer will prove immediate in its effect.

Cheap and pure gas being the desideratum, what can we do more than has been done in the past to further its attainment? We have been told very recently by Mr. Livesey (than whom no one can be more devoted to the interests of his profession) that gas manufacture, since its commencement, has not made the same progress as other manufactures, and he attributes this in a great measure to the absence, in the case of gas managers, of any direct pecuniary interest in the success of their several undertakings. A similar opinion has likewise been expressed by Mr. Bennett, in the paper which he read last June at the meeting of the parent Association, and what he says upon the subject, as coming from one who is not himself a gas manager, deserves our serious considera tion. Mr. Bennett, indeed, does not hesitate to express his conviction that a much more extended and profitable business is likely to reward the efforts of those who take pains to seek it, and there must be many who think with him. While, however, agreeing cordially with much that has been advanced by both gentlemen, I feel by no means convinced of the soundness of their conclusions as a whole; or that gas managers, as a rule, deserve all that has been said of them. There is no doubt that competition and self-interest form two most powerful motives for exertion, but can it be said that either of them has been absent or untried in our case? Competition, for instance, existed until recently in almost all our largest towns, but it is not apparent that any one of them has been able to boast of having distinguished itself by any special progress in the art of gas manufacture, nor is it by any means clear that the amalgamation of the undertakings has in one single instance proved detrimental to their development. In London, until about 1860, competition existed in its most virulent form; but was the period immediately preceding 1860 noted for anything more famous than the establishment of the Great Central gas company, the natural outcome of the wasteful systems which then prevailed; and is it not a fact that the districting arrangements, by which at length competion was put an end to, have proved of the greatest possible benefit alike to shareholders and consumers? Those who being dissatisfied with our present rate of increase, are casting about for a cause for it, will hardly find one to their liking in the entire absence of competition at the present day; competition between gas undertakings have been tried and found wanting.

Probably we are all agreed with Mr. Livesey that gas managers should be sharers in the wealth they help to create, and, in the absence of such participation, it is not surprising that they are occasionally wanting in that absorbing interest in their profession often to be found in other brances of industry. There can, I think, be little doubt that the general adoption of a system of payment by results would prove advantageous all round, and there can be but few who would not welcome such a change; but the difficulties in the way of its adjustment are great, although, probably, not insurmountable; and it is to be observed that, while justifiable solely from a commercial point of view, the commercial aspect, pure and simple, is fast disappearing from gas undertakings, through their absorption by local authorities.

Not withstanding, however, the absence, as a rule, of any such special motive for exertion, so abundant is the evidence of a general spirit of inquiry existing amongs them, isolated though they be, that it is impossible to say of gas managers as a body that they are not keenly alive to the interests of their profession, nor as zealous and energetic in the service of their employers as any set of men can possibly be. Whatever may be the reason for the apparent want o progress exhibited in our art since its infancy, it is hardly to be ascribed to the supineness or indifference of those whose daily occupation it has formed. Nor can it be attributed to any lack of interest on the part of the scientific men and others outside the profession, for numberless have been their efforts to improve us, as the records of the Patent Office bear witness. Every few years has brought out a succession of new schemes, or old ones revived, the names of which, still living in our memories, are all that remain of once promising inventions, for few indeed have passed beyond the experimental stage, and all, without exception, after lingering for a while in the speculative regions—too often speculative in more senses than one—have disappeared, serving no other purpose, it would seem, than to show how utterly incorrigible we are.

Nevertheless, the demand for coal gas as originally distilled, condensed, purified, and distributed, has gone on increasing, until its supply has become the gigantic industry we now see it. Are those who have devoted the best part of their lives to its development not entitled to any credit for the enormous proportions it has assumed, and are not the failures to which I have referred to be attributed, in some degree, at least, to something inherent in the nature of the thing striven for? Is it nothing to have reduced the selling price to about one-fifth or one-sixth of what it was originally, thus bringing what was formerly a luxury to within the reach of the humblest in the land, and to have achieved this result without the aid of any material alteration in the process itself, a process which has, over and over again, been demonstrated to be, in its main features, unalterable? Whatever science may yet have in store for us—and she can by no means have exhausted her aid—the rise and growth thus far of the system of gas lighting will remain an enduring monument to the skill and energy of our predecessors.

If, however, science has been less active on our behalf than for others; if some amongst us, conspicuous for talent, have found in other pursuits that field for their ingenuity which appeared to be denied them in our own, at least we can say that assistance of a very substantial nature has not been wanting to us. Thrift is the good genius whose help in the past has materially contributed to the prosperity of gas undertakings, by lessening the cost of production; and it seems not unlikely that in the future the most solid success will still reward those who continue to invoke her aid. Although many degrees removed from the waste which at one time was deemed to be unavoidable, much remains to be accomplished; as is made evident, for example, by a comparison of the total weight of products accounted for with the original weight of coal submitted for distillation. It is no exaggeration to say that the loss of gas, through pressure unwisely permitted at the moment of evolution within the retorts, and by leakage through defective distributing plant, amounts to from 15 per cent. of the total quantity generated in the best managed concerns, to 30 or even 40 per cent. in those which are less efficiently conducted. So large an amount of valuable illuminating matter, lost to the world demands from us our best efforts for discovery; for this is surely a "consummation devoutly to be wished" for, and viewed in the light of past experience, by no means hopeless of attainment. The late

Mr. Esson, of Cheltenham, long ago set us an example of what could be achieved in the way of improved carbonization by relieving the retorts of the pressure caused by the dip-pipes, and I trust that at some future meeting his successor, our esteemed fellow member, Mr. Paterson, may be induced to relate to us his experince in this direction. At the same time, signs are not wanting to show that those who have already succeeded in reducing their per centage of unaccounted-for gas to a moderate 6 or 7 per cent. are by no means disposed to "rest and be thankful;" so that we may fairly believe that the time is approaching when we shall be able to account on the right side of the balance sheet for all but an insignificant portion of the entire weight of coal delivered into the retorts.

On the subject of retorts, it is to be observed that machinery has lately been adopted in their manufacture, and it is claimed that not only is the cost thereby lessened, but that, being rendered more dense, the durability of the article is improved. On this latter point our experience is, perhaps, as yet, too limited to express any decided opinion, but so important a feature is not likely to be lost sight of.

The problem, how to dispense with, or diminish, the necessity for hand labor within the retort-house, has occupied much attention for a great number of years, until at last, after many failures, a gleam of success seems to be rewarding the persevering efforts of those who have devoted themselves to its solution. Foulis's hydraulic stoker may be said to have taken firm root in Manchester, where it is found to effect a considerable saving in the cost of carbonizing, and it is also under consideration for adoption at the Beckton works; while West's machines, coupled with the system of light charges at short intervals, are finding favor in many quarters.

Mr. Eidridge, of Richmond, very courteously gave me the opportunity, a short time ago, of viewing those in use at his works, and what I saw pleased me very much. Speaking generally, the endeavor to render automatical the present method of charging by hand, has actually resulted in an enormous waste of power, with only partial success: but Mr. West, by separating the two operations to be performed—namely, lifting the coal and putting it into the retorts, has avoided a difficulty which has too often proved fatal, and produced a machine at once simple, unpretending, and undeniably effective in diminishing to a great degree the necessity for manual labor. We may fairly welcome the introduction of these machines as a step in the right direction, and a valuable contribution to one of the most pressing questions of the day.

The system of light charges at frequent intervals, as practised by Mr. West, can hardly be described as new, inasmuch as it prevails to a considerable extent upon the Continent, where it is said to be productive of very satisfactory results. Certain it is that light charges are found to work off more gas per ton than heavy ones; and indeed upon this point it may be said, that a more intimate knowledge of the conditions under which evolution proceeds within the retort will inevitably reveal to us the fact that carbonization, as commonly conducted, is by no means the economical process that it ought to be. We may well believe that, without the aid of any adventitious methods, such as are almost daily forced upon our attention, and which are too frequently only so many blows aimed at the simplicity of the process, a greatly increased yield of gas is possible of attainment, and to this end our efforts should be directed.

The value of residual products, notably of tar and liquor, has undergone a complete change of late years, so that what were formerly little better than drugs in the market now contribute materially to the revenues of gas undertakings. Fortunately, it is almost needless, at the present day, to direct attention to the complete extraction of ammonia as our bounden duty, for, regarded solely from a commercial point of view, the suicidal policy of negligence in this respect is sufficiently obvious; and yet only a few years ago such neglect was all but universal, It may be said, "How shortsighted must the companies have been to allow such a state of things to continue for so long a period!" And there is much truth in such criticism, for too often this source of revenue has been overlooked. But then, on the other hand, it must be recollected that ammoniacal liquor, for a very long period, was worth very little; and also, that chemists were, at one time, by no means agreed as to the advisability of the complete removal of ammonia from the gas, it being urged, among other reasons for its retention, that its presence hindered the deposition of naphthaline. Whatever foundation there may have been for such belief, it is probably sufficient for us to know that such considerations have disappeared before the rapidly advancing value of this product, the proper place for which, it is now universally acknowledged, is not in the gas, but under the ground.

The exhaustion of the guano deposits has turned the attention of agriculturists to sulphate of ammonia as one of the chief sources whence to derive their supply of nitrogen for the soil, and the demand thus created, increased by the ever-growing necessity for higher cultivation, has been eminently favorable to its disposal, The result is consequently what we now see it, that gas liquor has maintained its position in the market throughout a period of almost unprecedented depression, affecting adversely every other product; nor is there any reason to believe that it will not continue so to do, for, in the opinion of the most competent judges, a yet greater demand may be expected for it in the future.

But not only is the gas manufacturer indebted to ammonia for a most important contribution to his revenue, it is at the same time a very valuable agent in the removal of the remaining impurities, and as such should be employed to the utmost possible extent before its final disposal. Indeed, purification by its means, in closed vessels, offers so many advantages over the ordinary methods that, as might be expected, many attempts have been made to supersede the latter, either wholly or in part, by perfecting the application of the former. If only ammonia were produced in sufficient quantity with the gas, then indeed the work of purification would be simply and inexpensively performed, and we should probably hear no more of the much vexed question of the sulphur compounds; but, as it is, we have to cast about for means whereby the quantity at our command can be employed over and over again. Hills's method, as practised by Mr. Livesey, enables this to be done to a considerable extent, and other processes are now offered having the same object in view, so that it can scarcely be a matter for speculation as to whether in the future ammonia will not come to the front as our primary purifying agent. Be it always remembered that coal gas contains within itself the materials for its own purification; it is for us to find out the proper means of employing them.

From the necessity for the removal of sulphur compounds other than sulphuretted hydrogen, gas managers in the provinces are, as a rule, exempt; for, with few exceptions, it is only the Metropolitan companies, who are subjected to pressure in this respect. The attainment, however, of a high standard of purity is really a matter which concerns us all, if we would extend, by every means in our power, the use of gas wherever applicable. There can be little doubt that the too often noxious character of the products of its combustion has hitherto retarded its employment for many purposes, and although overcome to a great extent by more perfect ventilation, it is surely, at least, as much our duty to endeavor to remove the cause, as it is to point out a remedy for the inconvenience complained of. While, therefor, sympathizing to the fullest extent with our brethren in the Metropolis in the difficult position in which the demands of the public have placed them, I think we should be wanting in appreciation of the necessities of the case did we not endeavor to meet these demands, rather than denounce them as unreasonable and exacting.

In designing the gas works, it is, of course, of the last importance that the details should be so arranged as to enable the various operations to be conducted with the greatest possible ease and consequent economy; nor will it now-a-days be admitted as a sufficient excuse for want of efficiency, that they were originally planned to suit a condition of things no longer existing. Our position with the public depends upon our being able to supply a cheaper source of light than they can obtain elsewhere, or by other means, and we cannot afford to neglect any precaution by which such position may be strengthened; otherwise, the lightest penalty that may ensue will be diminished profits, with attendant loss of capital.

Of the attention which has of late years been bestowed upon every part of the apparatus of gas-works, tanks and holders have naturally attracted to themselves a by no means inconsiderable share. In the construction of tanks, Portland cement concrete is now extensively employed, and where suitable material for it can be obtained upon, or near to, the site of the works, its cost compares favorably to that of brickwork; but it can hardly be said to be equally reliable, and needs to be used with caution, especially where the foundations are uncertain. In the present imperfect state of our knowledge as to the proper methods of mixing and applying concrete, it would seem that its use in blocks, bedded and jointed in the same way as stone, offers the best guarantee for stability, when employed for the construction of tank walls. Where such stability can be ensured, whether by means of brickwork or concrete, there can be but little doubt but that, in Portland cement rendering, we have a cheap and efficient substitute for clay puddle.

With regard to gasholders, the chief points of interest are the wrought or cast iron stanchions which, in a few instances, have been preferred to the ordinary cast-iron columns for the outside framing, and the abandonment of the trussed roof. In point of economy little is to be gained by the adoption of the stanchion; but it possesses, in the eyes of some, the merit of being lighter in appearance, and of having its strength concentrated in the direction in which it is most required; although, on the other hand, a column properly designed is capable, with the same weight of metal—cast for cast—of resisting the utmost strain to which it may be exposed in any direction.

The abandonment of the trussed roof, in holders of any considerable dimensions, materially reduces the cost of the structure, and, by diminishing the weight of the crown, adds to its stability; but, at the same time, a somewhat indefinite dread of the strain which, when the holder is in action, is supposed to be thus thrown upon the curb, has led to the strengthening of this latter to such an extent as to make a serious inroad into the previous saving. If, however, I for one entertain grave doubts as to the necessity for such precautions, it is because I am unable to conceive of any strain greater in extent than that which is due to the weight of the holder distributed; and that this is counterbalanced by the pressure within, exerted by the gas equally in all directions, is capable of easy proof. Consequently, the hope may not be in vain that a problem which has engaged the attention of some of our best mathematicians without result, will find a safe and practical solution in the gradual return to that simplicity of design which in the curb was formerly deemed adequate.

Well, gentlemen, when we have constructed our works upon the most approved modern principles, when we have done our best to apply to our manufacture all the most economical and efficient methods, and delivered our gas to the consumers with a minimum of loss, is there anything remaining for you to do? Yes, say our critics, your work is by no means complete, for you are nothing if you are not versatile. You should be prepared to advocate the claims of gas in season and out of season, and, by means of lectures and exhibitions, endeavor to familiarize the public with the many and economical uses to which gas may be applied. By so doing you will impart an additional stimulus to your business, the good effects

of which must soon become apparent, and, at the same time, you may, perhaps, succeed in removing some portion of the unpopularity which unfortunately too often attaches to gas undertakings.

We can hardly fail to recognize the soundness of this most friendly advive, nor, if possessing the necessary qualifications, should we hesitate to act upon it. It may be, however, that, as individuals, it is not permitted us to do all that we could desire in furtherance of an object so eminently calculated to promote our best interests, but as an Association it ought to be in our power to accomplish a great deal. Let us not, then, shrink from joining those who are already at work in the wide field before us, remembering always that our first aim is to cheapen production; but if, in addition to effecting this, we succeed, as time rolls on, in becoming, by its agency, better exponents of the article we manufacture, then surely this Association will not have existed in vain.—*London Journal of Gas-Lighting.*

Preparation of Ammonia from Gas Liquor and Uses of Ammoniacal Salts.

[From the Chemical News.]

The ammoniacal liquor, which collects partly in the condensers and partly in the washing apparatus of gas works, consists of a mixture of volatile and fixed salts of ammonia in very variable proportions. Among the former are ammonium sulphide and carbonate and free ammonia, whilst the latter consist mainly of the ammonium salts of sulpho-cyanogen and hyposulphurous acid, along with traces of the sulphate and chloride. The total percentage of ammoniacal compounds fluctuates greatly, but as it is to the advantage of the gas works to absorb the ammonia as far as practicable, and as concentration of the gas-liquor increases its values, it is now generally delivered stronger than was formerly the case.

The approximate valuation of the ammoniacal liquor is effected by means of a hydrometer, but as the specific gravity of the liquor is essentially affected both by the quality of the water originally used and by the presence of foreign constituents, the hydrometric valuation is very uncertain, as will appear from the following table, in which samples of gas-liquor of equal value, according to the hydrometer, but different in strength according to analysis, are grouped together.

Degrees Beaume at 15° C.

2°	2·50°	3°	3·50	4°	4·50°	5°	6°
1·16	1·30						
1·42	1·43						
1·50	1·63	1·63					
1·77	1·77	1·76	1·87				
	1·98	1·90	2·00				
	2·18	2·10	2·24				
	2·65	2·38	2·40	2·55			
		2·45	2·72	2·72	2·79		
				2·90	2·85		
				3·40	3·06		
					3·40		
					3·53	3·67	3·74

The percentage of fixed ammonia is, on the average, 0·3, whether the hydrometer indicates a higher or a lower degree. The percentage of sulphur ranges from 0·33 to 0·50.

The utilization of the liquor is generally effected by expelling the gas by distillation in iron boilers, which are heated either by direct fire or by steam, air being simultaneously forced in [J. Braby* and J. Baggs], Certain English manufacturers make use of apparatus resembling the scrubbers at gas works in which the gas liquor flows down from above, whilst the steam, at a high tension, rises up from below—a process objectionable in so far that such establishments can either not use lime at all, or must employ it under unfavorable circumstances.†

In the establishment of Messrs. Van der Elst and Matthes, of Amsterdam, the ammoniacal liquors from most of the Dutch gas works are treated for sulphate of ammonia as follows, having been brought by water in barges specially constructed:

The liquor is distilled in iron stills, holding from 35 to 50 hecto-litres each, and heated by steam, which is furnished by five steam boilers of thirty horse-power each. The stills are fixed at the same level, and are grouped in pairs, which can be worked alternately, being connected by reciprocating cocks.

The volatile constituents are first distilled off without the addition of lime, and then the quantity of milk of lime required for the decomposition of the fixed ammoniacal salts is driven in by steam pressure. The products of distillation pass first into a collecting vessel, and from here through 5-inch (13-centimeter) valve-cocks into large receivers filled with sulphuric acid, in which the ammonia is absorbed without the slightest loss, since the cocks are so arranged that the products may be conducted at will into one or the other receiver.

The residual watery vapor, plentifully contaminated with sulphureted hydrogen and carbonic acid, is removed from the receivers by a special chimney fitted with an arrangement for burning the sulphureted hydrogen.

The escaping vapor, on its way to the chimney, traverses prolonged series of pipes, which raise the temperature of the gas liquor about to be distilled to 50° or 60°. Besides an important economy in fuel, this arrangement produces the further advantage, that the gaseous mixture deposits a great part of its watery vapor, which greatly facilitates the combustion of the sulphuretted hydrogen.

The annual production at the works of Van der Elst & Matthes amounts to about 1200 tons sulphate of ammonia.

All establishments where gas liquor is treated in quantity, are compelled to pay great attention to the pernicious emanations which are inseparably connected with this manufacture.

Unless proper precautions are taken, not alone the residents in the neighborhood suffer from the copious development of sulphuretted hydrogen, but the men employed in the works are attacked with violent inflammation of the eyes.

The progress made in this direction consists, principally, in the improvement of the burners for the combustion of the noxious gas, and the construction of chimneys with increased draft.

The Compagnie Parisienne d'eclairage et de chauffage par le gaz, which, in its three large establishments, produces yearly about 3000 tons sulphate of ammonia, and, in addition, large quantities of caustic ammonia, has described, in a special treatise,* the arrangements adopted for the sanitary improvement of its works.

As another improvement, must be mentioned the safety-valves which are now attached to every still. Although, under ordinary circumstances, these apparatuses work at a very low pressure, obstructions may nevertheless be produced, in the gas delivery tubes, under a variety of circumstances, and may easily occasion explosions, such as took place in 1867, at the establishments of Van der Elst & Matthes, of Amsterdam, and of Kunheim & Co., of Berlin. These dangers are, once for all, obviated by the introduction of safety-valves.

AMMONIA AND AMMONIA SALTS.

BY M. SEIDEL, Director of a Manufactory in Amsterdam.

Applications of Ammonia.—As already mentioned, the consumption of sulphate of ammonia in agriculture has become more and more established. In comparison with guano, and with all putrescent manurial matters, this salt has the great advantage that all its ammonia is combined, and, although in consequence of this fact the effect is less rapid than that of guano, it is decidedly more permanent.*

The production of caustic ammonia likewise has manifestly increased. Large quantities are required by Carre's ice-machine, which, although still encumbered with a variety of defects, is daily finding a more extended application.†

Caustic ammonia is also more and more required in the tinctorial arts, and very recently it has unexpectedly come into use in the preparing of indigo in Java.

According to the old process for the preparation of the color from various species of *Indigofera*, lime was added to the fermenting mass. A Belgian chemist, J. Sayers, of Djocjocarta, in Java, has introduced there a new process. Instead of lime he adds ammonia during the fermentation, and is said in this manner to obtain a purer color.

The successful resumption of the method tried more than thirty years ago to produce soda by treating chloride of sodium with carbonate of ammonia, has also lately given a considerable impulse to the manufacture of ammonia. Should, as it almost appears, the ammonia-soda process come into use on a larger scale this circumstance would very essentially contribute to a further development of ammonia manufacture,‡

The condensibility of ammonia and its great solubility in water, have inspired the idea of using it as a motive power for machinery.

The earliest experiments in this direction are due to Tellier and Flandrin.‖ In connection with these attempts Tellier has subsequently sought to make ammonia useful in a variety of technological applications, but without arriving at any decided success, which may be partially due to the circumstance that the commercial value of ammonia has so greatly increased of late years. Tellier has collected his suggestions and published them in a separate work—"L'Ammonique dans l'Industrie." Paris: J. Rothschild, 1867. Delaporte§ has also patented an ammonia machine in France.†

We may, in conclusion, briefly mention a few proposals respecting the preparation of various ammoniacal compounds.

As is well known, ammonia is fixed not only by many salts, which, in this case, play the part of an acid. These compounds, which have been experimentally examined by H. Rose, Persoz, and Rammelsberg, give off the ammonia when heated, a property which is often used in the laboratory for the preparation of liquefied ammonia. Latterly Knab* has proposed to obtain such saline compounds of am-

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* J. Braby, *Chemical News*, xx., 182.

† The following description of the apparatus used in the manufacture of caustic ammonia at the works of Messrs. Jaffe & Darmstidter, of Berlin, has been communicated to the editor by Dr. L. Darmstidter. It consists of three superposed boilers, containing about 50 hectolitres, the two lower being heated by direct fire, and provided with agitators, to ensure a perfect commixture of the lime and the gas liquor, and to prevent the lime from burning to the bottom of the boiler. The upper boiler serves as a preparatory heater, and to a certain extent, as a dephlegmator. The gas from the third boiler is passed, for the removal of watery vapor, through an arrangement of Liebig's condensers as extended as possible, and, preferably, 20 to 25 meters in length, from which it finally escapes into the washing bottles and condensing apparatus, which are connected together by means of a tube filled with wood charcoal, for the absorption of any residual empyreumati. matter. By a sufficient length of the pipes, and by the interposition of more washing bottles, it is possible to obtain chemically-pure ammonia. In the manufacture of caustic ammonia, it is of course essential to introduce into the still, before the commencement of the operation, the whole of the lime needful for decomposition, as otherwise the resulting product may be easily contaminated by volatile ammoniacal compounds, such as ammonium sulphide and carbonate.

* Note relative aux divers produits et aux ouvrages exposes a Vienne par la Compagnie Parisienne.

* Recently repeated attempts have been made to extract by direct lixiviation, the ammonia which accumulates in the composition employed in gas works for purifying purposes (bog-iron ore and saw-dust) and to utilize it as manure. In consequence, however, of the abundant presence of sulphocyanide in the sulphate, and of its pernicious action upon vegetation, these experiments have led to no favorable result.—Private communication of Dr. Darmstadter to the editor.

† Compare the paper by Dr. Meidinger in an earlier portion of this report.

‡ According to private communications which the editor has received from German manufacturers, an increase of the demand for carbonate of ammonia, in consequence of its application to the ammonia-soda process, is as yet scarcely perceptible.—(A. W. H.)

‖ Tellier and Flandrin, *Comptes Rendus*, lx, 59; *Monit. Scientifique*, 1865, 134; *Ding. Pol. Jour.*, clxxvi. 163; *Deutsch. Industrie Zeitung*, 1865, 126; *Wagner Jahresbes.*, 1865, 279.

§ Delaporte, *Genie Indust.*, August, 1865, 63.

† Lamm, of New Orleans, is said (*Engineer*, Jan., 1875) to have constructed an ammonia machine, which has been successfully tried for street tramways; the chief difficulty, the loss of ammonia, is almost overcome by the use of an oil joint in the stuffing boxes.

* Knab. *Chem. News*, 1866, xiii, 192; *Deutsche Industrie Zeitung*, 1866, 178; *Wagner Jahresber.*, 1866, 205.

monia industrially, and to store up the gas in this form. Such compounds would then only require a gentle heat in order to evolve a current of dry ammoniacal gas. Chloride of calcium can in this manner take up 50 per cent. of its weight of ammonia, whilst strong liquid ammonia contains only 20 per cent. of dry ammonia. This latter assertion is an error, since water, even at 15°, is capable of taking up more than 30 per cent. of its weight of ammoniacal gas.

Ammonium sulphide, so frequently employed for analytical purposes, has been hitherto almost exclusively prepared by passing sulphuretted hydrogen into caustic ammonia. It is now obtained by Spence* industrially by mixing ammonium sulphate or chloride with twice its weight of alkali-waste or gas-lime, exposing the mixture to the action of steam, and condensing the products of distillation in suitable apparatus.

Kunheim† has introduced a simple, but under certain circumstances very advantageous, improvement in the manufacture of ammonium carbonate. Previously this salt had been almost exclusively prepared by the double decomposition of sal-ammoniac and carbonate of lime, the chloride of calcium, relatively worthless, being obtained as by-product. Kunheim employs, instead of carbonate of lime, the carbonate of baryta, and obtains a solution of baric chloride, which may be advantageously used in the preparation of permanent white.

[From "Saward's Coal Trade Journal"

On Coal Dust Explosions.

Even as long ago as the year 1812, we find coal-dust mentioned in connection with colliery explosions. In describing the disaster that occurred at that time in Feiling Colliery, the Rev. J. Hodgson says:

"In the forenoon of the 25th of May, 1812, the villages in the neighborhood of this colliery were alarmed by a tremendous explosion. The subterraneous fire broke forth with two heavy discharges from the John pit, followed by one from the William pit. A slight trembling, as from an earthquake, was felt for about half a mile round the workings; and the noise of the explosion, though dull, was heard to three or four miles distance, and much resembled an unsteady fire of infantry. Immense quantities of dust and small coal accompanied these blasts, and rose high into the air in the form of an inverted cone. The heaviest part of the ejected matter, such as curves, pieces of wood, and small coal, fell near the pit, but the dust, borne away by a strong west wind fell in a continued shower from the pit to a distance of a mile-and-a-half. In the village of Heworth it caused a darkness like that of early twilight, and covered the roads so thickly that the footsteps of the passengers, were strongly imprinted in it. The heads of both the shaft frames were blown off, their sides set on fire, and their pulleys shattered to pieces—those of the John pit gin being on a crane, not within the influence of the blast, were preserved. The coal dust ejected from the William pit into the drift or horizontal parts of the tube was about three inches thick, and soon burnt to a light cinder. Pieces of burning coal, driven off the solid stratum of the mine, were also blown up this shaft." In speaking of the explorers, he says, amongst other things: "Being, therefore, deprived of light, and nearly poisoned for want of atmospheric air, they retraced their steps to the shaft, and then attempted to pass up the narrow boards; in these they were stopped at the sixth pillar by a thick smoke which stood like a wall the whole height of the board. With difficulty they found their way to the pit bottom, persuaded the mine was on fire, and before they had all ascended another explosion, though less severe than the first, took place." After this it was concluded there could not be any one still alive in the mine; and an air-tight stopping of clay and straw was put in at the bottom of the William pit for the purpose of excluding the air and extinguishing the fire. On the 8th of July the workings were again entered, and the work of recovering the bodies commenced. Altogether, ninety-two men and boys perished by this catastrophe; in one place twenty-one were found thrown together, "some like mummies, scorched as if they had been baked." "The power of fire was visible upon all."

Again, on the 24th of December, 1813, another explosion, by which twenty-three persons were killed, occurred in the same mine. It could not be satisfactorily estabiiahed, however, whether this accident was attributable to falls in the air-way having disturbed the ventilating furnace; but the ventilation of the mine was considered so good that "the persons employed were unanimous in declaring that they never wrought in a pit so pleasant and wholesome."

The first of these events gave rise to the formation of an association of gentlemen whose object was to call the attention of scientific men to the subject, and obtain suggestions from them which might lead to a more secure method of lighting the mines. The society was established at Bishop-Wearmouth on the 1st of October, 1813; but the prevailing opinion of most of those who attended the first meeting was that the object they had in view was both "chimerical and visionary."

However, Sir Humphrey Davy was induced to investigate the matter by a private letter from Dr. Gray, rector of Bishop-Wearmouth. In August, 1815, he visited Newcastle-on-Tyne, and had an interview with Mr. Buddle, and before the end of the same year he had discovered the principal of the safety-lamp, and made several lanterns or candle-guards, which were safe in an explosive mixture.

From the preceding accounts it will seem that.

1. Felling Colliery explosion was the direct incitement to the proceedings which led to the invention of the safety-lamp.

2. The description of this explosion might, without much alteration be substituted for the published account of almost any other explosion of magnitude that has taken place within the last sixty years—not excluding those of Pemberton and Blantyre (October, 1877).

Thus we have:—The explosion, the flame bursting from the shaft at the surface, the cloud of coal-dust raised in the air above the mouth of the shaft, the smoke below ground, the fire in the workings, the second explosion, the closing up of the workings to extinguish the fire, the re-opening of the workings to recover the bodies, the difficulty of accounting for the disaster, and lastly, in the case of the second, at any rate, the unanimous declaration of the miners, "that they had never wrought in a pit so wholesome or pleasant."

In addition to most of these particulars, we are generally told, regarding a modern explosion, that *charred* or *burnt* timber or coal, or *traces of fire* were observed here and there, on the sides or roof of the galleries; that an outburst of gas had probably taken place at the time; that a shot which had been fired had, no doubt, some connection with the event; or that both of the two last phenomenon had, in all likelihood, acted simultaneously; so nearly so in producing results that could not be accounted for in any other conceivable manner.

3. It is a perfectly legitimate conclusion, deducible from the unconstrained and unsophisticated narrative from which we have quoted, that some, if not most of the roadways in Felling Colliery were covered with dry coal-dust immediately before the explosion; and that, during the continuance of the blast, the air contained in these suspended in it, in consequence of the sudden disturbance to which it was subjected.

We find it very often stated, in regard to great explosions of recent date, that the workings had been examined shortly before and were considered to be free from the presence of firedamp; and then two more or less perplexing questions present themselves for solution, namely: 1. How did the explosion originate? 2. How can its magnitude be explained? but, as there are generally no survivors who can throw any light on the subject, it devolves upon those who investigate the matter to reply as best they can.

The first question can be answered in most cases, either directly or by induction. For instance, small, local explosive accumulations are constantly being formed in cavities in the roof, or in badly ventilated places in fiery mines, damp from a more or less open crevice or blower; or owing to the partial stoppage of the ventilating current, caused by neglect of ventilating power or a fall of the roof in one of the airways; or, lastly, when the means employed for distributing the air current is deranged accidentally. It is thus easy to account for the presence of a little fire-damp at any time, even immediately after an examination has been made, if it can be assumed, or established that one or more of these causes began to act in the meantime.

With regard to its ignition, we know that a naked light must be applied either in the form of a lamp flame or blasting shot; but we need not stop in this place to inquire how this is generally done. Slight non-fatal explosions are continually occurring in shallow damp mines where naked lights are employed, or where the regulations regarding the use of the safety lamps are not stringently enforced, and we have only to turn to a consideration of the circumstances by which they are always preceded and accompanied in order to form a very fair idea of how the same kind of events can be accounted for in other cases. It must be mentioned, also, that ignition can be transmitted through the wire gauze of some kinds of safety lamps when they are exposed to a sudden vibration of the atmosphere, or to the action of a rapid current while burning in an explosive mixture of fire-damp and air.—W. Galloway, in *Iron*.

Early History of the Steam Engine.

Miss Anna Gurney writes to *The Times* from the Reeds, near Bude, Cornwall: "Trevithick, in 1804, was the first person who made a steam-engine move itself from one place to another: the term 'locomotive' was probably given to it by Mr. Davis Gilbert, president of the Royal Society, who was aware of all Richard Trevithick's experiments, and at whose house, in Cornwall, my father, the late Sir Goldsworthy Gurney, when a youth, frequently met him. Trevithick placed his engine on a railway, temporarily made for the purpose, at Euston Square, London, in 1813. My father saw it there, and afterwards, when R. Trevithick went to the mines of Peru, my father took up the subject, and in a few years gave up his practice as a medical man, and perfected the locomotive engine, with which he made a journey from London to Bath on July 28th, 1829, performing the return journey at fourteen miles an hour, or the eighty-four miles in nine hours and twenty minutes, stoppages for fuel and water included. His steam carriages ran four times a day for four months between Gloucester and Cheltenham, in 1831, going 4000 miles, and carrying three thousand passengers without accident or injury to any one. The laying on of turnpike tolls by Act of Parliament (amounting, in one case for instance, to eight guineas at a gate) was fatal to locomotives on common roads. But the means of obtaining the sustained rapid speed which my father's inventions had produced gave sudden success to the railway locomotive, when first applied to it three months after the famed London to Bath journey in 1829; and the railway system, as we now have it, then commenced."

A massive granite cover stone, on which the cross is sculptured, has lately been placed in the churchyard at Launcells, near Bude, bearing the following simple inscription: "Sir Goldsworthy Gurney. Died February 28, 1875: aged 82 years." To his inventive genius the world is indebted for the high speed of the locomotive, without which railways could not have succeeded, and would never have been made.—*Iron*.

* Spence, *Mech. Mag.*, Nov., 1866, 307; *Dingl. Pol. Journ.*, clxxxiii, 397; *Polyt. Centralb.*, 1867, 461.

† Kunheim, *Deutsche Indust. Zeit.*, 1866, 178; *Chem. News*, 1866, xiii, 192; *Wagner Jahresber.*, 1866, 202.

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SATURDAY, FEBRUARY 16, 1878.

Official Report of Examinations of Gas for two Weeks ending Feb. 9, 1878, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Date. Jan. 1878.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
28	Between 10 A. M. and 3 P. M.	17.04	17.84	19.94	17.17	16.33	
29		17.13	17.52	19.98	17.23	14.88	
30		16.20	16.98	18.78	16.79	15.02	
31		17.68	16.08	19.38	16.93	16.18	
Feb. 1		17.57	16.18	18.09	16.49	16.28	
2		15.28	16.41	18.96	15.59	15.46	
	Average	16.81	16.83	19.19	16.70	15.69	
4		16.36	16.34	18.48	17.88	15.05	
5		16.38	17.38	18.72	17.81	15.35	
6		17.65	17.48	20.98	16.67	16.11	
7		16.60	16.87	19.32	16.80	15.46	
8		16.65	17.51	18.37	16.52	15.13	
9		16.44	16.39	17.91	16.84	15.46	
	Average	16.68	16.99	18.96	17.08	15.42	

Sugg-Letheby burner.
E. G. LOVE, Gas Examiner.

Extract from Report of Gas Trustees, Philadelphia.

"During the past two years we have thoroughly tested two new processes for the manufacture of gas, viz.; The Spencer process and the Lowe process, both of which have proved unsatisfactory to both consumers and to the Trust, and have been dispensed with."

Gas-Light Intelligence.

United States.

DIVIDEND DECLARED.—The Metropolitan Gas-Light Company of this city has declared its usual semi-annual dividend, viz., five per cent. on stock, and three and a half per cent. on certificates, payable on demand.

OBITUARY.—Mr. A. Hamilton Dodge, President of the Georgetown (D. C.) Gas Company, a well known citizen and brother of Treasurer Dodge of the district government, died suddenly at his residence in that city, on Sunday night, 3rd inst.—*N. Y. World.*

POPULAR LECTURE ON GAS.—Mr. Charles H. Nettleton gave an interesting lecture Monday night on the subject of "Gas." A small retort was exhibited, illustrating its manufacture, the manner of purifying gas explained, and a glass meter was shown in operation. The audiance was the largest that has ever attended, and was well repaid.—*Derby Transcript, Jan.* 17, 1878.

[An intelligent explanation of the subject of gas manufacture and use in the manner above mentioned, must result in increased consumption and decreased grumbling. The consumer is much better satisfied if he thinks he knows "all about it," and as a general rule, the consumer is fully competent to understand all the practical points which most need to be illustrated. This is a good example, which must result in good, not only to the customer but the gas company.]

Great Britain.

CONVICTION OF STOKERS FOR NEGLECTING WORK.—At the Greenwich Police Court, on Tuesday the 8th of Jannary, before Mr. Balguy, John Thompson, stoker, George Steele, scoop driver, and John Butler, stoker, appeared to summonses under the Employers and Workmen Act, charging them with absenting themselves from work without leave or notice, and for which a claim was made upon each for £1 compensation. The defendants had been in the employ of the Phœnix Gas Co. at the works at Greenwich, and they formed three of a gang whose duty was to work during the night of Sunday, the 23rd ult. The three defendants, who lived in one house at Deptford, failed to attend at six o'clock in the evening, and other men had to be sought for to take their places. This caused a delay of an hour, the retorts being left empty, more fuel being burnt, and the neighboring consumers being liable to have been put to inconvenience. Mr. Rolton, foreman of works, proved that printed notices were posted at all parts of the works that a week's notice was required on both sides as to discharging or leaving, and Mr. Wates, the engineer at the works, said he had moderately estimated that the loss sustained by defendants' absence was £3. The defendants, he said, were good workmen, earning 38s. per week, but since November last had twice similarly misconducted themselves, of which no notice had been taken. The Company regretted having to take the present proceedings, and although the summonses must be pressed, he would promise, if they made amends, to take them back again. That morning there were seventeen men absent, a state of things which frequently happened after receiving pay, or at holiday time. Thompson and Steele pleaded guilty, complaining that there was no holiday allowed, and they had to take one; and Butler excused himself by saying he was unwell, suffering from pain in the back, but he offered no such excuse some days afterwards, when he went to the works and was discharged. Mr. Balguy said there were hundreds and thousands of men in the mining districts who would be glad to have employment and wages the defendants had deprived themselves of. In making the orders asked for, to pay £1 each to the Company and 2s cost of each summons, he advised them to see the engineer, and again go to work.—*Gas Trade Circular and Review.*

[From the London Journal of Gas-Lighting.]

The Revivification of Foul Lime.

Sir: The information contained in your issue of the 6th instant, concerning the attempt being made at Paisley to revivify foul lime, renders it possible to discuss the applicability of this method of revivifying by reburning, at least as far as London is concerned. This method of burning fouled lime in the flare of a furnace is by no means new; but until last week no figures, I believe, had been published that would enable one to form an idea as to cost. Now, 8s. 6d. per ton would not be cheap for a lime containing perhaps 20 per cent. of sulphate, when we take into consideration that the purifiers would have to be emptied and recharged more frequently, and that labor would be a larger item.

In your article dated October 23, you anticipate the production of sulphate when lime is reburned in the ordinary method. This would infallibly occur if there were sufficient oxygen present to convert the sulphide into sulphate; besides, experience points to this conclusion. However, I think I can indicate how this difficulty could be met without the use of a current of hot steam. It would be easy to burn the lime in such a manner as to leave the sulphur combined as sulphide, and not as sulphate, which, once formed, is not to be easily got rid of, and is of no use for purifying purposes. By treating the calcined material immediately after being raked out of the calcinining chamber, whilst still hot, with hot water thrown on with a pail, or by any other simple means, one-half the sulphide is converted into hydrate of lime, and one-half into sulphydrate, according to the reaction shown in my last letter. In works where oxide is used, this small proportion of sulphydrate is of no moment; for carbonic acid will combine just as readily with the lime of the sulphydrate as with the lime of the hydrate. The only objection to the presence of the sulphydrate is the diminished efficiency with regard to the sulphuretted hydrogen, which deficiency would not be felt where oxide is used for removing the greater proportion of the sulphuretted hydrogen.

Of course, by far the larger part of the lime used in the most modern processes of purification is neutralized by carbonic acid, as a consideration of the following formulæ and figures will show:

$$CaO, H_2O + CO_2 = CaOCO_2 + H_2O.$$
$$CaS, H_2S + 2H_2S = CaS, H_2S + 2H_2O.$$

The lime combines with carbonic acid in the proportion of 56 to 44; with sulphuretted hydrogen in the proportion of 56 to 66. These two impurities exist in gas, as ordinarily presented to the purifiers (after efficient scrubbing), in about the following quantities, calculated to purified gas: Carbonic acid, 1·57 per cent. of volume, 12·7 grains per cubic foot by weight; sulphuretted hydrogen, 1·37 per cent, of volume, 8·7 grains per cubic foot by weight. Assuming these quantities to be true for the majority of cases, there will, in theory, be required of lime (CaO) 1·08 lb. for the sulphuretted hydrogen, and 2·31 lbs. for the carbonic acid.

In cases where no oxide is used, these figures will well represent the respective proportions of lime used for the extraction of those two impurities, viz.: 32 per cent. of the lime for sulphuretted hydrogen, and 68 per cent. for the carbonic acid.

In certain processes where the sulphydrate and the carbonate are to some extent distinct, doubtless two different processes of revivification would be required. The process described in my previous letter would meet the former case, with the production of bisulphide of carbon; and the process now described would be useful for the latter case, if the production of sulphate be apprehended and its avoidance desired.

Before closing this letter, permit me to point out a material nearly analogous to gas lime—the waste from the alkali works. This, according to the text-books, is sulphide of calcium (CaS); but after being exposed to the action of water and air, it has, with some minor exceptions, such as sulphocyanides, etc., an almost identical composition to the gas works refuse that has been exposed. When in the north of England lately, amongst the chemical works, I was informed that there was then no practical process for the revivification of this waste, and that it was removed at great expense, in most cases being shot into the sea. The history of this material and that from the gas works tells us that the question is one most difficult of solution, but whether a more profound knowledge of the chemistry of these materials will lead to complete success is a tale to be told in the future—the age of (to quote your own words) "the most perfect utilization of residuals." Whether the time will come when gas companies will have the same interest in the removal of bisulphide of carbon from the gas, as they now have from ammonia, I know not; but that is an idea neither Utopian nor chimerical I think I have shown. In the meanwhile we must await events.

LEWIS T. WRIGHT.

23, Sutherland Gardens, W., Nov. 8, 1877.

On the Relative Attraction of Oxygen for Hydrogen and Carbonous Oxide.

Bunsen, in his "Gasometric Methods," has given the results of an examination of the products formed when hydrogen and carbonous oxide are mixed with oxygen in quantity insufficient to burn them both completely, and exploded; from which he draws the conclusion that the atomic ratio of the combustion produces ($H_2O : CO_2$) is always represented by simple numbers, changing from one to the other *per saltum* as the proportion of hydrogen varies. Horstmann has experimented anew in this direction and has obtained quite different results. He finds:

1st. That when electrolytic gas and carbonous oxide are mixed and exploded, following the method used by Bunsen, the proportion of the former gas being continually increased, vapor of water and carbon dioxide are formed in a constantly increasing ratio. Thus while the hydrogen, relatively to the carbonous oxide, varied from 0·25 : 1 to 2·33 : 1, from 20 to 70 per cent. of the mixture being burned, the ratio of the combustion-products ($H_2O : CO_2$) varied from 0·8 : 1 to 4·5 : 1. Nothing like a sudden change of ratio was anywhere observed.

2nd. That when to a mixture of carbonous oxide and hydrogen, increasing quantities of oxygen are added and the whole exploded, as in E. v, Meyer's method, aqueous vapor and carbon dioxide are formed in a constantly increasing ratio, no "preference for rational values" being detected. Hence the author maintains that the division of the oxygen between these two combustible gases does not take place according to the law laid down by Bunsen. As to the cause of the discrepancy, he says, that while his experiments were made with dry gases in dry tubes, he has observed that when aqueous vapor is present in the tube, less hydrogen and more carbonous oxide is burned. The ratio of $H_2O : CO_2$ is always lessened, and the more, the greater the amount of moisture present. On the other hand, in presence of carbon dioxide, more hydrogen and less carbonous oxide is burned.

Now v. Meyer's experiments were made with moist gases, and Bunsen's partly with dry and partly with moist gases. Moreover, the variation in the ratio of the combustion-products is peculiar. As the oxygen increases, this ratio at first increases, reaches a maximum, when the amount of combustible gases burned is about 30 to 35 per cent., and then falls uniformly again to the limiting value reached when the combustion is complete. The law according to which the oxygen divides itself between the combustible gases, is thus expressed:

The ratio of the aqueous vapor formed to the carbon dioxide is equal to the ratio of the unburned hydrogen to the unburned carbonous oxide, multiplied by an affinity-coefficient, which is independent of the proportion in which the combustible gases are present, but which varies with the relative quantity of oxygen added. The relation between this coefficient and the necessary quantity of oxygen being fixed empirically in the case of one proportion of such a mixture, it may be readily calculated for all others. This coefficient, in Horstmann's experiments varied from 4·0 to 6·4, when between 20 and 70 per cent. of the combustible gases was burned, the maximum being reached at 30 to 40 per cent. In other words, the ratio of the aqueous vapor to the carbon dioxide was 4 to 6·4 times as great as the ratio of the hydrogen to the carbonous oxide in the unburned residue. Since therefore relatively more hydrogen is always burned than carbonous oxide, the attraction of oxygen is greater for the former than for the latter gas. The variability of the affinity-coefficient itself is due to the fact that with the relative quantities of oxygen, the physical conditions change under which the reaction takes place. With a fixed quantity of oxygen it remains constant, not only when the proportion of hydrogen to carbonous oxide varies, but even when the unburned portions of the combustible gases are wholly or partially replaced by an indifferent gas with similar properties; as, for example, nitrogen.—*Ber. Berl. Chem. Ges.*, x, 1626, Oct., 1877.

The Rothschonberger Water-Adit.

After thirty-three years of uninterrupted labor the great undertaking of the Rothschonberger water-adit is so far completed as to admit of its use. The method of draining the Freiberg mines by means of a deep tunnel had already been discussed in the beginning of the present century, as a question of necessity for the future mining prosperity of the vicinity; and, undoubtedly, the Rothschonberger tunnel is the greatest work of the kind that has ever been undertaken to aid the exploration of a mining district. Other great adits, such as those of the Hartz Mountains, and the famous Sutro tunnel, fade when compared with a tunnel which has already attained a length of more than 26 English miles, and will be with its branches, when completed, more than 31¼ miles. The plan was to conduct the water from the Freiberg mines to the nearest practicable point on the river Elbe. Rothschonberg, about 7½ miles above Meissen, was chosen as the most advantageous place for the mouth, on account of its having the lowest level at the shortest distance from Freiberg. The preliminary surveys were made in 1843, but the work was not thoroughly taken in hand until the third quarter of 1844. Since that time the driving of the tunnel has been unceasingly carried forward, but has met with many hindrances and difficulties, such as quicksands, immense quantities of water, etc., which have trebled the cost and retarded its completion. The tunnel is ventilated by eight air-shafts, and lies some 400 feet below the deepest Freiberg water-adit. It has a uniform height of 9·84 feet, with a somewhat smaller breadth. The present length of the adit, with its ramifications, is about 25 miles (all of which length is now in use), and will be when completed over 5 miles more.

The cost of the tunnel is estimated at £600,000, and will be paid for by a tax on all the mines which it directly benefits.

The gradient of the floor is only 1 in 33. This small gradient may make it necessary to clear the tunnel occasionally, but this can be accomplished without difficulty with suitable boats and dredges. For five miles this tunnel is perfectly straight, without the slightest curve, and along the whole length the curves are light.

One rather interesting occurrence during the past year was the striking of an old mine, of which no maps are in existence. The mine is probably more than four centuries old, and the timber which had been used for supports, etc., was found for the most part sound. Two new veins were also struck, but only one of them will be explored. It is rather remarkable that nearly the whole driving of the tunnel has been done by hand, Burleigh drills, driven by compressed air, having been introduced only within the past year. The rock throughout nearly the entire length is solid gneiss, which accounts for the time that has been taken to the work, it being necessary, with hand boring, to put as many as from 40 to 50 holes to the face.

The necessity for the continued prosperity of the Freiberg mines, which have now been worked for about seven centuries, may be gathered from the fact that there are more than 6,000 laborers, with their families, amounting to some 20,000 persons altogether, who derive sustenance from the mines and metallurgical works connected with them. It may reasonably be expected that the Rothschonberger tunnel will give fresh impetus to the Freiberg mining, and considerably augment the output of ore, which has of late years considerably fallen off, owing to the immense quantities of water which continued to flood the mines, and prevented the veins of ore being followed and worked below a certain depth. Saxony may well and justly be proud of a tunnel which is without doubt the longest in the world, and which has required so much time, perseverance, skill and labor as the Rothschonberger water-adit.—*Iron.*

Relative Cost of Water and Steam Power.

BY HENRY P. M. BIRKINBINE.

When erroneous statements are put into print, it is almost impossible to correct them. An evidence of this is presented in an assertion contained in the article under the above head, in the JOURNAL for December, page 388: "The cost of raising water by water-power at the Fairmount Works in Philadelphia is but *two cents per one million gallons*, raised one foot high."

In an article published in the JOURNAL for May, 1876, page 323, the commercial value of Fairmount water-power is presented, and figures given, taken from the reports of the Water Department, which show that, as compared with steam, the water pumped by the water-power works was, at a cost of from $13,000 to $19,500 per annum, above what it would have cost to have done the work by steam, with pumping engines of the same average efficiency as those in the works.

The two cents referred to, as the cost of raising one million gallons, one foot, by water-power, were expended for simply running the works, that is, attendants, oil, tallow, and ordinary repairs; it does not represent the entire cost of operating the works; it leaves out of consideration the extraordinary repairs, incident to water-powers, those of maintaining the dam, head-race, gates, etc.

The water-power at Fairmount has cost the city of Philadelphia between one, and one and a quarter millions of dollars for water-rights, damages, dam, head-race, mill-houses, wheels, and pumps. The precise cost is difficult to ascertain, as many of the expenditures were made in connection with other work. Taking the interest of one million dollars ($60,500), as the annual cost of the power, and dividing it by the water pumped in 1876, 8,314,657,743 gallons lifted into the reservoirs, it will show that the power alone cost over eight cents per million gallons, lifted one foot. To this must be added the running expense, two cents, and also the cost of extraordinary repairs, incident upon maintaining the dam, head-race, etc. It is therefore evident that the cost of raising water at Fairmount by water-power, is between ten and twelve cents per million gallons, one foot.

The water-power on the Schuylkill, next above Fairmount, at Manayunk, owned by the Schuylkill Navigation Company, and leased to eighteen different manufacturing establishments, has a power equal to one thousand horses; and for this power the company receives a yearly rental of $43,100, or $43.50

per horse power, per annum. Even at this low figure, it is a question which is the cheapest, water or steam, when the annoyance of low water floods, and interferences of the navigatian are taken into account. Were this power now unoccupied, the yearly rental would not warrant its utilization, simply for a water-power.

Since the steam engine has been brought to the degree of perfection, in simplicity, efficiency, economy, and reliability, that we now have it, there are few locations in the thickly settled portions of our country, where fuel can be procured at a moderate price, that water-power will be found cheaper or more desirable than steam-power. This is particularly the case where the water-power is unfavorably located, and where the trouble, incident to drought, floods, etc., is taken into account. There are unimproved water powers in this vicinity, and many which have been improved are now unemployed and allowed to go to decay.—*Jour. Franklin Institute.*

Delicate Machinery.

The mechanical machinery at the Bank of England, says the *British Trade Journal*, is marvelously perfect. It may not be generally known that the London bankers, when the standard weight of the working sovereigns is suspected, send these into the Bank of England, the suspected coins being kept separate and weighed one by one, and the light sovereigns charged to the debit of the banking house that delived them. To large concerns like Glyn's, the London and Westminster, Barclay's, and the National Provincial, the debit account for light gold foots up at the end of the year to a large amount. The deficiency in the weight is caused by abrasion in the constant wear and fingering of the gold currency.

The machines which weigh the sovereigns are numerous, about twelve or fourteen. They are driven by an air engine, and are fed through long tubes placed in an inclined position over the machines, and one by one these clever machines weigh them, and, like stern sentinels pass the honest sovereigns to the right hand, but without ceremony, kick the light one, which is found wanting, into another basket. These machines are beautiful. Their perfect automatic action excites admiration.

The sovereigns which pass this infallible and equally inflexible judge are put into bags and have the honor of again asserting their honest value in the busy world. With regard to those which have been placed in this beautiful balance and found wanting, they are cut to pieces and afterwards cast into a burning fiery furnace at the Mint, and there regenerated in full weight and measure, made bright and beautiful, and impressed with the image of Queen Victoria.—*Scientific Press.*

Preservation of Wood.

[Edward B. Andrews, before the Massachusetts Institute of Technology.]

The timber supply in this country is very great, and the necessity for preserving it is not so imperative as it is in Europe; yet, even if we need not for the present fear the exhaustion of our supply, the cost of working timber and of replacing it every few years is an enormous expense to this country. Facts, however, show that our supply of timber is being rapidly exhausted, and its preservation must, ere long, engage the attention of practical men.

According to Mr. C. D. Robinson, is an article in *Scribner's Monthly* for December, the United States are now producing timber products to the amount of ten thousand million of feet annually, enough to load 50,000 vessels, each carrying 200,000 feet, or nearly a million and a half railroad cars, making a train 7,500 miles long. As the home consumption and export are equal to the product, it will be seen that our apparently inexhaustible supply cannot stand such a drain indefinitely. Probably half a century of such forest destruction would exhaust our timber supply. The consumption of timber in New England is far greater than her production.

In Massachusetts alone, allowing the life of chestnut railroad ties to be six years, the annual renewal of ties on her 2830 miles of single track: with an average of 2500 ties to a mile, requires about 38,550,000 feet, or nine-tenths of the whole production from Maine in 1875, at an expense of nearly $1,200,000 to the stockholders. The eight railroads terminating in Boston replace about 800,000 ties every year, at an expense of as many dollars. This is the greatest expense connected with the permanent way, and might be reduced seven eighths in six years if the same results attend the use of creosoted ties here as are realized in England and on the continent.

Taking the life of ties in the whole country as four years, our 80,000 miles of track, with their 200,000,000 ties, of which 50,000,000 are replaced every year, the annual consumption of timber for this alone would require 1,000,000,000 feet, or nearly one-sixth of the production of the country.

Creosoted ties will last in England twenty years; if the same results follow here, the saving would amount to three per cent. per annum on the average cost, $30,000 per mile of the railroads—a handsome dividend.

The annual consumption of wood for telegraph poles, which must be of the best kinds of wood, and which decay just at the surface of the ground, so that their life is not more than ten years, is 43,500,000 feet, nearly equal to the whole product of Maine. Creosoted poles in England, in use for twenty-five years, show no signs of decay.—*Polytechnic Review.*

Water Tanks.

Alfred Wright, Secretary of the Chicago Board of Underwriters, has issued the following circular, dated January 16:

In view of the disasters which have resulted from the location of water tanks in the upper stories of buildings where fires have occurred, and with the conviction that similar or still more calamitous consequences are likely to follow where such destructive agencies are permitted to exist, this board is forced to insist upon the observance of the following stipulations in their construction and arrangement:

All water tanks, if constructed of wood, must be open at the top; if of metal or other material than wood, they shall rest upon a foundation of brick, or some walls of solid masonry, or upon heavy iron girders, both ends of which shall rest upon solid brick or stone walls.

On all buildings (with their contents) having water tanks not constructed in conformity with above standard, a charge of not less than 10 cents per $100 will be added to the basis rate.

This action shall take effect from this day; but on any building now provided with tanks not conforming to above requirements, if altered and constructed in compliance therewith, before March 1, 1878, this charge of 10 cents will be rebated. If the change be not effected before March 1, then the rebate will only be allowed from the date of the improvement.—*Amer. Exch. and Review.*

Chemical Society.

Thursday, January 17, 1878.

The first paper was entitled "On the Luminosity of Benzol when Burnt with Non-Luminous Combustible Gases," by F. Frankland and L. T. Thorne.

It was pointed out by Dr. Frankland in 1852 (*Memoirs Manchester Lit. and Phil. Soc.*, 2nd Series, x., 71) that hydrogen, carbonic oxide, and marsh gas practically contribute nothing to the luminosity of coal gas, and that the only constituents of value were benzol, ethylene, propylene, butylene, and acetylene. The authors have endeavored to determine the luminosity of benzol individually, and propose in future papers to make similar experiments on the other illuminating constituents of coal gas. Many attempts were made to burn benzol with a smokeless flame, and several lamps were constructed by Mr. Silber, but all the experiments yielded unsatisfactory results, and the authors had to limit their experiments to the determination of the luminosity of benzol vapor, after dilution with hydrogen, carbonic oxide, and marsh gas. These three gases were severally prepared in the usual way, and were passed through a brass cylinder, 6½ inches long, three inches internal diameter, packed with sponge saturated with pure benzol, the whole being kept at a constant temperature by immersion in water. The quantity of benzol in the gas was determined by absorption with sulphuric acid. The authors obtained the following numbers.

1 cubic foot of benzol vapor burnt with hydrogen gas for one hour the light of	69·71 candles.
Ditto with carbonic oxide	73.38 "
Ditto with marsh gas (1st series)	92·45 "
Ditto with marsh gas (2nd series)	93 94 "

at the standard temperature and pressure. Hence, 1 lb. avoirdupois of benzol gives, when burnt with hydrogen, the light yielded by 5·703 lbs. of spermacetti; with carbonic oxide, 6·100; with marsh gas (1st series), 7·682; with marsh gas (2nd series), 7·803; or in other words, a given weight of benzol produces 5·3 per cent. more light when it is diluted with carbonic oxide, and between 32·6 and 34·7 per cent. more light when diluted with marsh gas than when diffused in hydrogen. The authors point out that this difference is probably due at all events in part to the different pyrometric thermal effects of the gaseous mixtures. A fish-tail burner was used throughout the experiments.—*Chem News,*

Mineral Statistics of the United Kingdom —The mineral statistics of the United Kingdom, which have just been published, present some points of much interest. The production of coal, notwithstanding the stagnation of trade, goes on increasing, and last year no fewer than 135,344,766 tons were raised. In 1755, 131,877,105 tons were produced, and it is noteworthy that the additional two million tons raised last year were exported. The change that has taken place in the value of coal is shown in the statement that the 133,844,766 tons raised last year were valued at only £46,670,661, while the 127,016,747 tons raised in 1873 were valued at £47,631,280. This change in the value of coal is, of course, beneficial to the interest of gas companies, while it testifies to a depression of our other manufacturing industries, and, if it continue, must lead to serious consequences. There are, however, signs of a revival, and it is doubtful whether the coal contracts for next year will be made on such favorable terms as obtained this year. The returns we quote from show that the manufacture of iron, notwithstanding the stagnation of trade, considerably increased during the last year, but evidently without an improvement in the rate of profit. Both coal and iron seem to us to have reached their lowest rates last year, and we have now, we hope, to look forward to improvement, which, if in some respects detrimental to gas companies, must tend to the advantage of the general community.—*Journal Gas-Lighting.*

Prices of Gas Coals.

Prices of American Gas Coal continue without change—no movement yet in the way of contracts for next season's delivery. The supplies are ample, and there appear to be no reason for any change from last year's prices. Receipts by steamer both from the Provinces and Newcastle continue the low prices of these coals, as compared with Domestic, attract the attention of consumers, who find them desirable as a mixture with our own coals.

Westmoreland	$5.50	$4.50	at Baltimore.
Penn	5.50	4.50	

Despard	5.35	
Marion	5.35	
Murphy Run	5.35	
Newburgh Orrel	5.35	
Ches. and Ohio RR. Caking Coal	5.40	($4.10 f. o. b. at Richmond.
Block House	4.50	1.75) Gold f. o. b.
Glace Bay	4.25	1.60) at Mines.
International	4.25	1.60)
Clover Hill	4.00	
Cannelton Cannel	10 00	
Peytona	10.00	

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks,

(with W. R. Scott & Co.,)

24 Pine Street, New York City.

February 16, 1878.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Central, Westchester	466,000	50	85	90
Harlem	$1,850,000	50	90	95x
Manhattan	4,000,000	50	205	210
Metropolitan	2,500,000	100	130	133
" Scrip	$1,000,000	...	100	103
" Bonds	500,000	1000	92½	95
Mutual	5,000,000	100	87	90
" Bonds, gold.	900,000	1000	—	105
Municipal	1,000,000	100	90	97
New York	4,000,000	100	118	120
Suburban, W'steh'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	155	160
Citizens	1,200,000	20	75	80
" Scrip	320,000	1000	95	97½
Peoples	2,000,000	10	—	40
" Bonds	$ 325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	—	78
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	110	116
" Scrip		...	98	101
Union Co. E N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	80	90
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	--
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	132	---
Fort Wayne, Ind		100	...	---
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L. I	25,000	100	...	---
Jersey City	386,000	20	155	165
Jamaica, L. I	25,000	100	...	---
Jacksonville, Ill	120,000	50	82	...
Lewistown Maine	400,000	100	70	—
Lima, Ohio,	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo.	1,200,000	100	100	110
Long Branch		20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	--	27
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	—	56
" Bonds			106	---
Perth Amboy		25	---	95
Rochester, N. Y		100	50	60
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97

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St. Louis Gas-Light Co., St. Louis.
New Orleans Gas-Light Co., New Orleans, La.

For particulars address as above— 426—1ylam

Advertisers Index.

GAS ENGINEERS.

	Page.
William Farmer, New York City	84
James H. Walker and Son, Milwaukee, Wis	84
E. S. Cathels, Montreal, Canada	81
George W. Dresser, New York City	84

GAS WORKS APPARATUS AND CONSTRUCTION.

Herring & Floyd, New York City	85
T. F. Rowland, Greenpoint, L. I	85
J. W. Starr & Son, Camden, N. J	85
Deily & Fowler, Philadelphia, Pa	85
Kerr Murray, Fort Wayne, Ind	85
George Stacey & Co., Cincinnati, Ohio	85
Brown & Owen, Philadelphia, Pa	85
Mackenzie & Sayre Man'f'g Co	85

GAS AND WATER PIPES.

McNeals & Archer, Burlington, N. J	80
Gloucester Iron Works, Philadelphia, Pa	80
Campbell, Brick & Co., New York City	80
James Marshall & Co. Pittsburgh, Pa	80
R. D. Wood & Co., Philadelphia, Pa	80
S. Decatur Smith, Philadelphia, Pa	80
H. R. Smith & Co., Columbus, Ohio	80
William Smith, Pittsburgh, Pa	80
B. S. Benson, Baltimore, Md	8
Warren Foundry and Machine Co	80

PIPE CUTTING MACHINES.

A. C. Wood, Syracuse, N. Y.	83

RETORTS AND FIRE BRICK.

Evans & Howard, St. Louis, Mo	83
J. H. Gautier & Co., Jersey City, N. J	82
B. Kreischer & Son, New York City	83
Adam Weber, New York City	82
Gardner Brothers, Pittsburgh Pa	82
Laclede Fire Brick Works, St. Louis, Mo	82
Brooklyn Retort and Fire Brick Works	82
Borgner & Obrien, Phila, Pa	83

GAS METERS.

Harris, Griffin & Co., Philadelphia, Pa	86
American Meter Co., Philadelphia, Pa	87
W. W. Goodwin & Co., Philadelphia, Pa	87
Harris, Heime & McIlhenny, Philadelphia, Pa	87

VALVES.

Charman Valve Manufacturing Co., Boston, Mass	88
Ludlow Valve Manufacturing Co., Troy, N. Y	88

EXHAUSTERS.

P. H. & F. M. Roots, Connersville, Ind	82
Smith & Sayre Manufacturing Co., New York City	86

GAS COALS.

Penn Gas Coal Co., Philadelphia, Pa	61
Provincial Gas Coals, Perkins & Job, N. Y & Boston	61
Cannelton Coal Co., " " " "	61
New York & Cleveland Gas Coal Co., Pittsburgh, Pa	61
Newburgh Orrel Coal Co., Baltimore, Md	91
Despard Coal Co., Baltimore, Md	81
Tyrconnell Coal Co., Baltimore, Md	61
Fort Pitt Gas Coals	91

COKE SHOVELS.

Butler's Patent, New York City	81

BURNERS.

C. H. Meyer & Co., Philadelphia, Pa	84
C. Gefrorer, Philadelphia, Pa	84

PROCESSES.

Gwynne Harris, New York City	85
Wren, Brooklyn, N. Y	86
Lowe, Philadelphia, Pa	79

GAS FIXTURES.

The Perfect Gas Heater	86
Mitchell, Vance & Co., New York City	84

CEMENT.

S. L. Merchant & Co., New York City	87

CARBON IN RETORTS.

G. W. Edge, Jersey City, N. J	7

LAMPS.

J. G. Miner	84

BOOKS.

Fodell's Book-Keeping	87
Kidd's Guides	87

GAS MACHINES.

Walworth Manufacturing Co., Boston, Mass	87
Springfield Gas Machine Co., Ne York City	87

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[From the American Gas-Light Journal, Oct. 2, 1877.]

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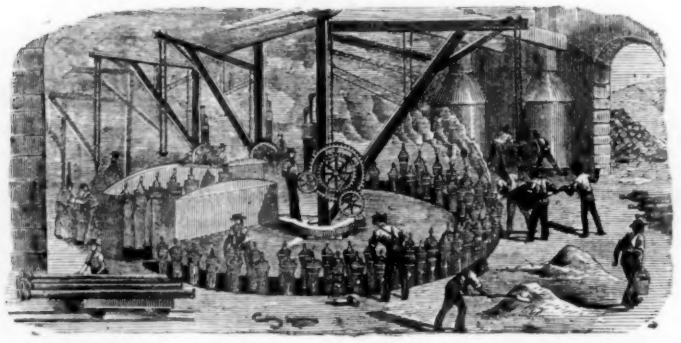

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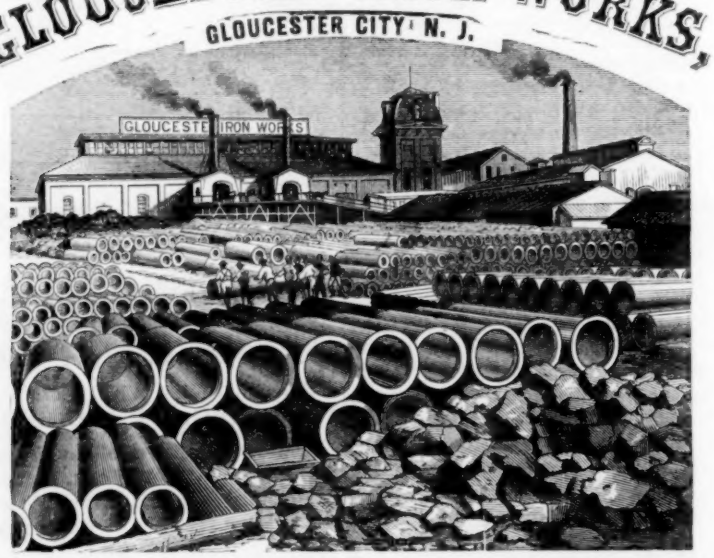

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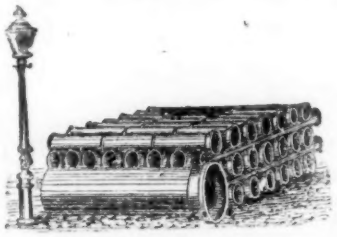

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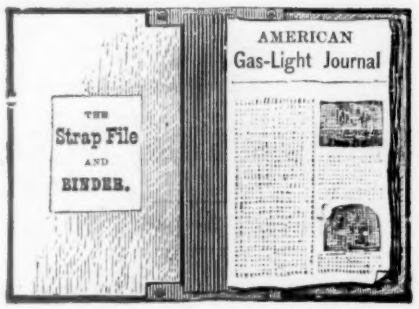

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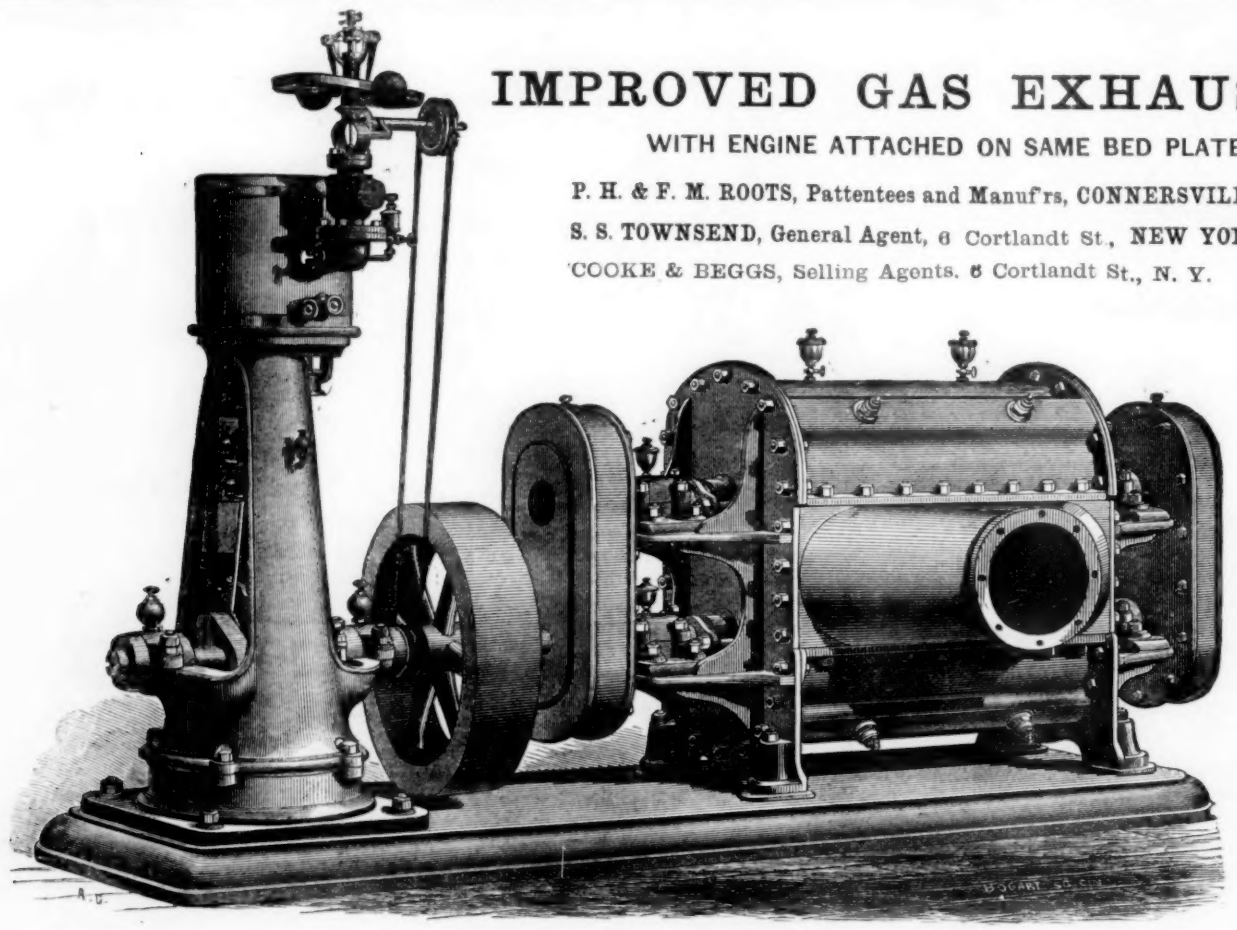

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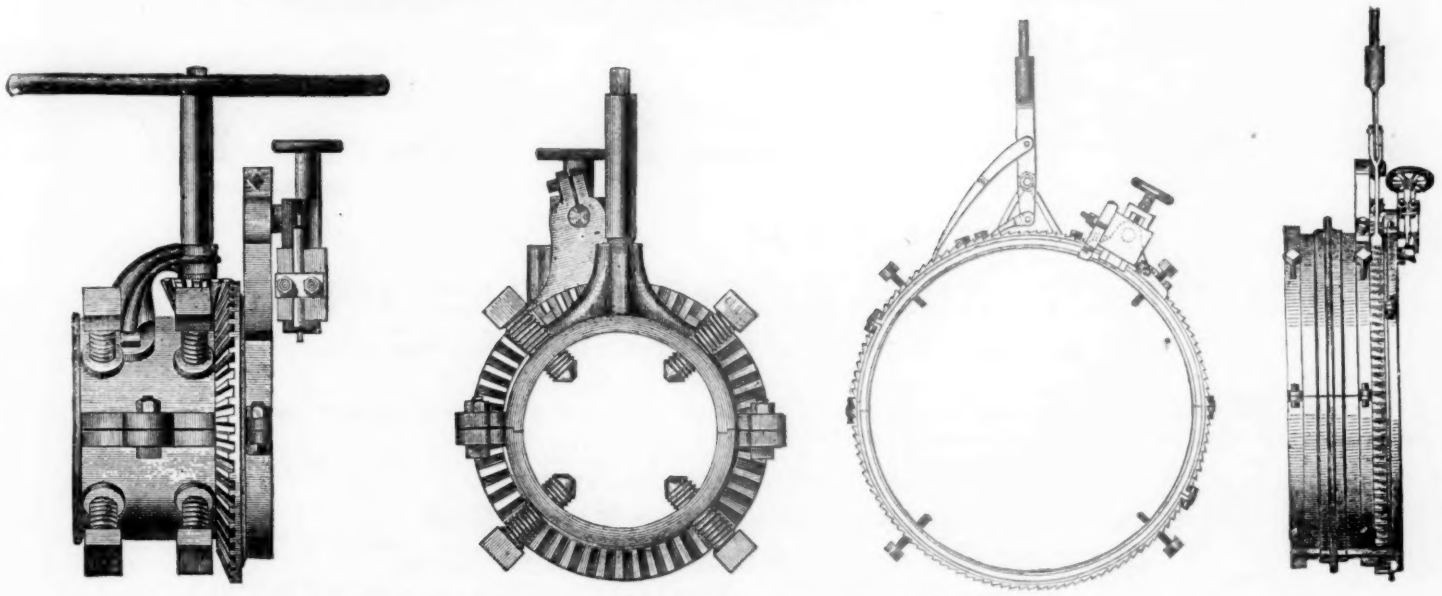

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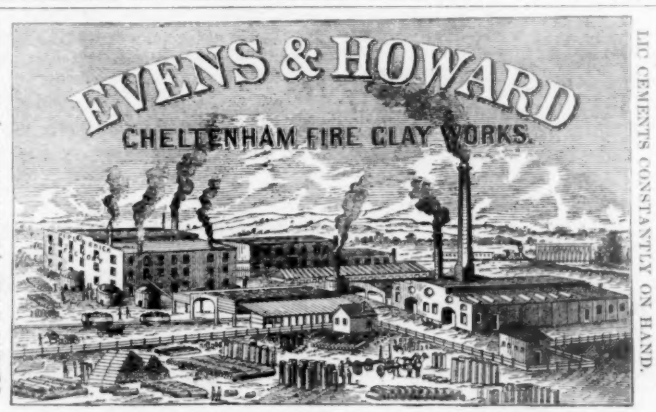

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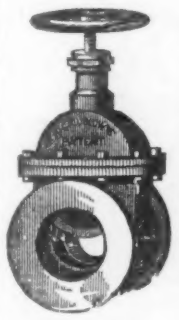

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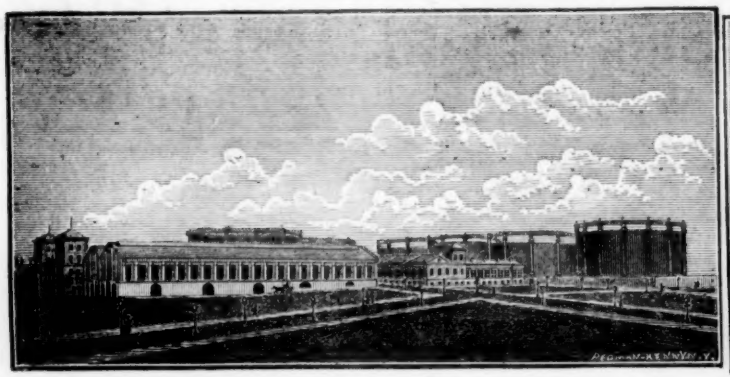

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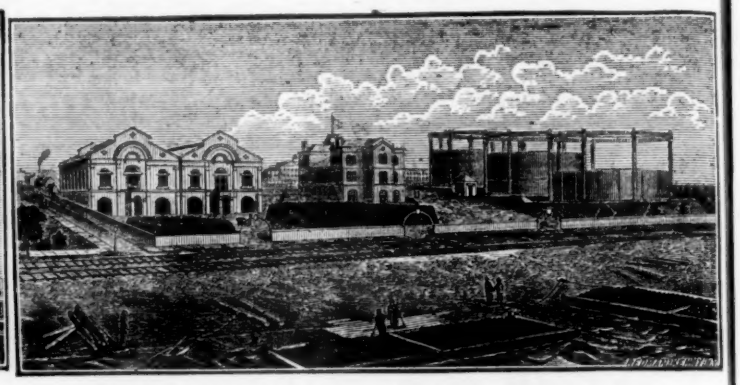

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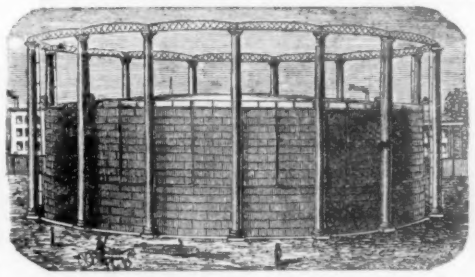

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Attest—J. L. CAMPBELL, Secretary, pro-tem. Signed—A. T. GOSHORN, Director General. J. R. HAWLEY, President.

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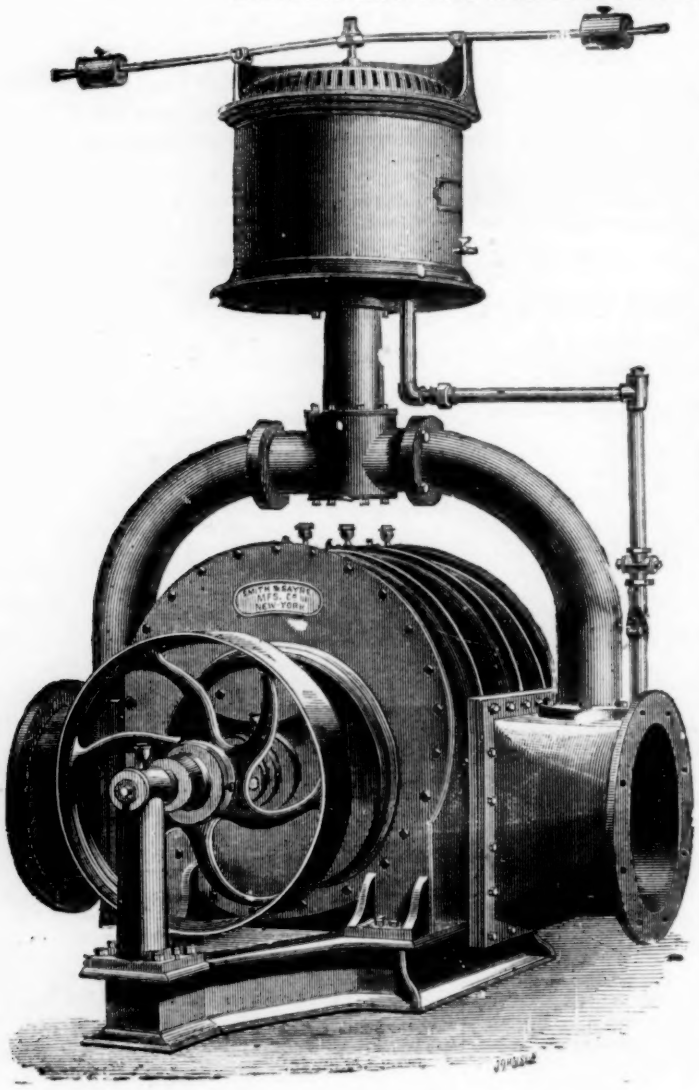

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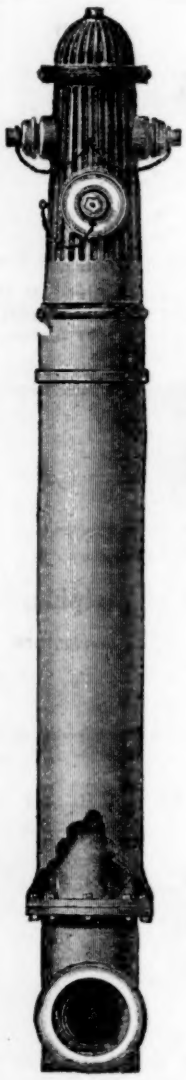

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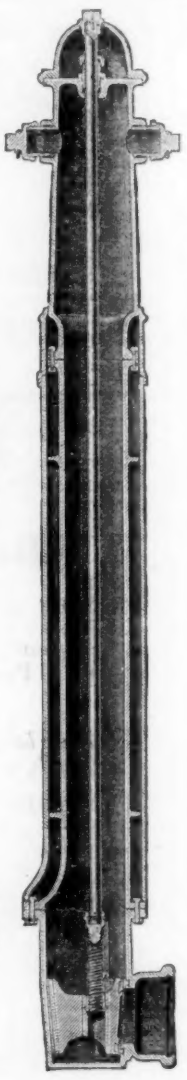

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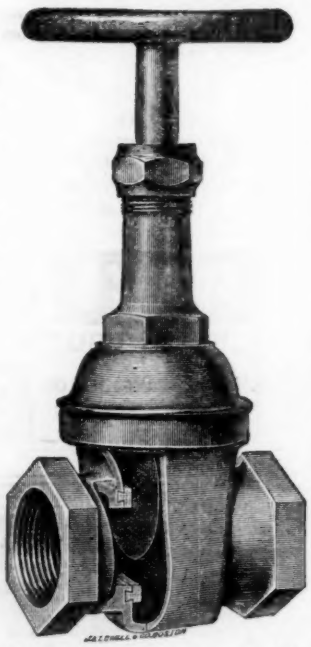

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